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STORM WATER MANAGEMENT REPORT

A Storage Place - Hancock

**Water Quality and Storm Drainage Management for a
Storage Building Development Site**

City of Newberg

Yamhill County, Oregon

7 September 2016

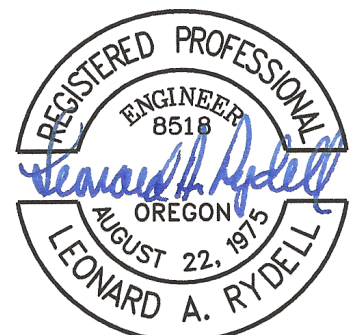
PREPARED FOR:

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RENEWAL DATE 12/31/2016

**PLANNED DEVELOPMENTS • RESIDENTIAL SUBDIVISIONS
WATER, SANITARY SEWER AND DRAINAGE SYSTEMS
LAND SURVEYS • WATER RIGHTS**

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INTRODUCTION

This Storm Water Management Report was prepared to accompany the Site Design Plan Review and a Building Permit Application by the City of Newberg as part of the development of a 2.8803 acre parcel to allow construction of storage buildings on a tract of land bordering Elliott Road and Hancock Street in the City of Newberg, Yamhill County, Oregon.

The property is identified as Tax Lot 1001, Map No. 3-2-20AA. The site generally drains North to South to a low point at the midpoint of the South line on Hancock Street.

There appears to be little offsite water draining onto the site as the surrounding developed sites collect and drain storm water runoff into facilities located on their site, so the drainage basin is considered to be only the area of the development site.

The existing site is mostly grass except for the paved fire access along the West boundary. There are no trees or shrubs on the property, and there are no springs, water sources or observable channels on or into the project. There is a 36-inch diameter storm drain in a 20.00 foot wide public easement that flows Southwesterly across the center of the site that serves upstream properties. Storm runoff from the site, when it occurs, sheet flows to the South center of the property where it overflows the curb into a low point in the curb and into a catch basin on Hancock Street. This catch basin and storm drainage system will be used for storm water disposal from the site.

The site appears to be either original ground or a fill site for excess materials from the surrounding developments. The fill was probably placed in 1979 or 1980 as part of the Airpark Local Improvement District.

The West portion of the site is occupied by a paved fire access road to the storage buildings to the North, a fire hydrant and a concrete storage enclosure for a drop box. The concrete storage enclosure has a trapped catch basin that connects to a storm drainage system that serves the development to the North. This fire access road drains to a swale along the East edge of the paved fire access road into a trapped catch basin that discharges to the existing storm drainage system in Hancock Street. This sub basin drainage area contains 12,175 square feet or 0.2795 acres, and since it drains off of the site separately, this area is excluded from the 2016 Phase One development storm water detention calculations.

Drawing "1520-SR1.DWG" shows a Google Earth Image of the site along with the existing Time of Concentration Calculations. The Time of Concentration for the undeveloped site is calculated to be 14.6 minutes.

Drawing "1520-SR2.DWG" shows the same information without the Google Earth Image of the site along with the existing Time of Concentration Calculations.



Soil types on the NRCS web site include:

2300A—Aloha silt loam, 0 to 3 percent slopes.....Ah.....Hyd Group C/D
 2301A—Amity silt loam, 0 to 3 percent slopes.....Am.....Hyd Group C/D
 2306A—Dayton silt loam, 0 to 2 percent slopes.....Dc.....Hyd Group D
 2310A—Woodburn silt loam, 0 to 3 percent slopes.....WuB.....Hyd Group C

According to the “Soil Survey of Yamhill Area, Oregon”, soil characteristics are:

Type	Hyd Group	Depth to Water Table	Depth	Permeability (in/hr)
Ah	C	18" to 20"	0" to 60"	0.2" to 0.63"
Am	C	12" to 16"	0" to 18"	0.63" tp 2.0"
			18" to 60"	0.2" to 0.63"
Dc	D	Soil Surface	0" to 15"	0.2" to 0.63"
			15"-28"	< 0.06"
			28"-60"	0.2" to 0.63"
WuB	C	30"	0" to 19"	0.63" to 2.0"
			19" to 60"	0.06" to 2.0"

PROPOSED DEVELOPMENT

A low impact sustainable development is proposed for the project to minimize the impact of the development on the neighboring down street property and to serve as a demonstration project for future developments.

Site development will occur in phases with Phase I including a 19,550 square foot, two story building with individual storage units, an office, and a manager's unit on the second floor.

To avoid decreasing the time of concentration with the resulting increased peak flows, it is proposed to rely on surface drainage flows rather than piping. This entails:

1. Surface drainage across all paved areas that discharge into vegetated flow through swales or rain/infiltration gardens. Per the soils testing report, raw infiltration rates without a factor of safety range from 0.24 to 0.36 inches per hour.
2. Discharge of building down spouts onto the pavement and surface flow to the vegetated swales or down spouts.
3. Flow spreaders in perimeter swales to slow runoff velocities, encourage dirt and dust particles to settle out, increase contact time with vegetation, provide temporary storage in increase the time of concentration.

Proposed improvements include installing rain gardens and planter strips along the East, West and South sides of the proposed Phase I building. These rain gardens will provide water quality treatment and storm water detention for the initial phase and full development of the entire project.

It is the intent of this project to conform to "Oregon Drainage Law" which apparently is Oregon's adoption of "civil law" as stated in the ODOT Hydraulics Manual, the first paragraph of which states:

"Under this doctrine, adjoining landowners are entitled to have the normal course of natural drainage maintained. The lower owner must accept water which naturally comes to his land from above, but he is entitled to not have the normal drainage changed or substantially increased. The lower landowner must not obstruct the run-off from the upper land, if the upper landowner is properly discharging the water."

NEWBERG ENGINEERING STANDARDS

Water Quality Improvements

Water Quality Improvement requirements are defined by the “City of Newberg LIDA Sizing Form, Standard Detail 451 of the City of Newberg Public Works Standards.

The use of rain gardens and swales are proposed to meet the water quality improvement requirements. Small check dams will convert the perimeter swales into rain gardens, allow infiltration, provide water quality treatment, and slow down runoff by providing temporary detention.

Two LIDA sizing forms were prepared, one for Phase I improvements, and the second for full development of the site.

As shown by the forms, the site more than meets water quality requirements for the initial development as well as the proposed maximum full development of the site..

Storm Water Detention

Newberg’s Storm Water Detention Standards state the following:

- III. When required, stormwater quantity on-site detention facilities shall be designed to capture runoff so the post-development runoff rates from the site do not exceed the pre-development runoff rates from the site, based on 24-hour storm events ranging from the ½ of the 2-year return storm to the 25-year return storm. Specifically, the ½ of the 2, 2, 10, and 25-year post-development runoff rates will not exceed their respective ½ of the 2, 2, 10, and 25-year pre-development runoff rates; unless other criteria are identified in an adopted watershed management plan or storm drainage basin master plan.

While the standards require 1/2 of the two year runoff rate for a 2-year storm plus the runoff rate for the same 2-year storm, and since you can only have one rate per event, runoff rates were calculated to provide detention for 1/2 of a 2-year storm, a 10 year storm and a 25-year post developed storm.

The detention facility needs to be placed at the low point of the site with an available storm water disposal system. Therefore, it is placed at the low sag of Hancock Street. The outlet pipe at the catch basin is 12-inch concrete which has a calculated flow rate of 2.73 cubic feet per second for concrete pipe at an assumed slope of 0.5% which greater than the maximum inflow of 2.60 cubic feet per second for a 25-year event at full development.

Time of concentrations for the original site were calculated based the SCS formulas and the runoff track shown on Sheet 1 of the drainage area exhibits. A Pre-Developed Time

of Concentration of 14.6 minutes and a Post Development Time of Concentration of 5.2 minutes was calculated. A spread sheet of the calculations is attached in the exhibits.

Since the West Fire Access already exists, calculations for Phase I excluded that area, but it is included in the full site calculations.

The pervious and impervious areas were calculated and entered into HydroCAD, a software program for calculating storm water runoff. Pre-Developed runoff rates for were calculated for the East portion of the site (excluding the fire access flows) and the entire site (including the fire access flows) as follows:

<u>Event</u>	<u>Phase I Outflow</u>	<u>Entire Site Outflow</u>
1/2 of 2-Year	0.385 cfs	0.44 cfs
2-Year	0.77 cfs	0.88 cfs
10-Year	1.32 cfs	1.50 cfs
25-Year	1.61 cfs	1.82 cfs

These pre-developed outflows from the site were used for the storm water calculations.

An "Outflow Control Structure" per City of Newberg Standard Detail No. 417 was used for the outflow device. Through trial an error, it was found that a solution could be had for both Phase I and Full Development by using one orifice and the overflow inlet grate for the second device. The second grate for full development would be raised 0.39'. Results are as follows:

	<u>Orifice Dia</u>	<u>Orifice Invert</u>	<u>Grate Invert</u>	<u>Max. H2O Elevation</u>
Phase I	3.75"	181.75	183.05	183.32'
Phase II	3.75"	181.75	183.44	183.75'

Flow rates are as follows:

FLOW SUMMARY (cfs)

<u>Event</u>	<u>Phase I Runoff</u>		<u>Full Dev. Runoff</u>	
	<u>Pre-Dev</u>	<u>Post-Dev</u>	<u>Pre-Dev</u>	<u>Post-Dev</u>
1/2 of 2-Year	0.385	0.38	0.44	0.43
2-year	0.77		0.88	
10-Year	1.32	1.07	1.50	1.22
25-Year	1.61	1.53	1.82	1.82

CONCLUSIONS

1. Based on the City of Newberg LIDA Standards, the partially and fully developed site will meet the required Water quality Standards.
2. Based on the City of Newberg Storm Water Detention Standards to detain fully developed storm water runoff to predeveloped conditions, the project as proposed meets the detention standards to detain 1/2 of a 2-year, a 10-year and a 25-year event.

FILE NAME: SCS-TC.WB3

DATE: 7 September 2016

TIME OF CONCENTRATION PER SCS - NE - PRE DEVELOPED

PRE-DEVELOP (2 YR)

RUN	BEGIN	END	LENGTH	BEG.	END	SLOPE METHOD	MANNINGS			FT/SEC	RUN TOTAL	
	STA	STA		ELEV	ELEV.		"K"	"N"	"I" or "D"		TIME	TIME
RUN NO. 1	0.00	100.00	100.00	190.30	188.54	1.76% Kin.Wave		0.15	2.50		11.7	11.7
RUN NO. 2	100.00	145.51	45.51	188.54	187.79	1.65% Shallow	11	0.03		1.41	0.5	12.2
RUN NO. 3	145.51	222.40	76.89	187.79	186.94	1.11% Shallow	11	0.03		1.16	1.1	13.3
RUN NO. 4	222.40	262.41	40.01	186.94	186.20	1.85% Shallow	11	0.03		1.50	0.4	13.8
RUN NO. 5	262.41	316.35	53.94	186.20	184.92	2.37% Shallow	11	0.03		1.69	0.5	14.3
RUN NO. 6	316.35	334.45	18.10	184.92	183.71	6.69% Shallow	11	0.03		2.84	0.1	14.4
RUN NO. 7	334.45	373.32	38.87	185.00	183.49	3.88% Channel	17	0.03		3.35	0.2	14.6
TOTAL TIME TO OUTLET											14.6	

TIME OF CONCENTRATION PER SCS - NE DEVELOPED

PRE-DEVELOP (2 YR)

RUN	BEGIN	END	LENGTH	BEG.	END	SLOPE METHOD	MANNINGS			FT/SEC	RUN TOTAL	
	STA	STA		ELEV	ELEV.		"K"	"N"	"I" or "D"		TIME	TIME
RUN NO. 1	0.00	70.18	70.18	190.04	189.00	1.48% Kin.Wave		0.011	2.50		1.2	1.2
RUN NO. 2	70.18	79.66	9.48	189.00	187.90	11.60% Shallow	11	0.03		3.75	0.0	1.2
RUN NO. 3	79.66	134.07	54.41	187.90	187.31	1.08% Shallow	11	0.03		1.15	0.8	2.0
RUN NO. 4	134.07	204.01	69.94	187.31	186.59	1.03% Shallow	11	0.03		1.12	1.0	3.0
RUN NO. 5	204.01	251.73	47.72	186.59	186.04	1.15% Shallow	11	0.03		1.18	0.7	3.7
RUN NO. 6	251.73	301.46	49.73	186.04	185.72	0.64% Shallow	11	0.03		0.88	0.9	4.7
RUN NO. 7	301.46	364.46	63.00	185.72	184.88	1.33% Channel	17	0.03		1.96	0.5	5.2
RUN NO. 8	364.46	397.75	33.29	184.88	184.26	1.86% Channel	17	0.03		2.32	0.2	5.4
RUN NO. 9	397.75	419.39	21.64	184.26	183.87	1.80% Channel	17	0.03		2.28	0.2	5.6
RUN NO. 10	419.39	443.43	24.04	183.87	182.75	4.66% Channel	17	0.03		3.67	0.1	5.7
TOTAL TIME TO OUTLET											5.2	

City of Newberg LIDA Sizing Form

(Include this form with plan submittal)

Project Title: _____

Project Address: _____

Project Taxlot/ Taxmap#: _____

Project Location: _____

Contact Name/Title/Company: _____

Phone/e-mail: _____

STEP 1: Determine Impervious Area Requiring Treatment

Total Gross Site Area (acres): Pre. Dev. Impervious Area (ft): (X)

Proposed Net New Impervious Area (ft): (PA) Post Dev. Impervious Area (ft): (Y)
(PA) = (Y) - (X)

STEP 2: Deduct Impervious Area LIDA Credits

Porous Pavement (sq. ft.): (P)

Green Roof (sq. ft.): (G)

Other Credits as approved (sq. ft.): (O)

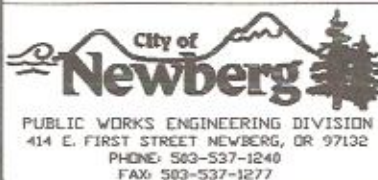
Total Credits (sq. ft.): (C)
(C) = (P) + (G) + (O)

Impervious Area
Requiring Treatment (sq. ft.): (IA)
(IA) = (PA) - (C)

STEP 3: Size LIDA Facilities for Remaining Impervious Area

	Impervious Area Treated (sq. ft.)	SF, Sizing Factor	LIDA Facility Size (sq. ft.)
Infiltration Planters/ Rain Garden		0.045	
Flow-through Planter		0.060	
Public Flow-through Planter		0.060	

Total Impervious Area
Treated (sq. ft.) MUST BE EQUAL TO (IA)



REVISIONS:

LIDA SIZING FORM

SCALE: N.T.S.
DATE: MARCH 2014
APPROVED BY: JAY H.
STANDARD DRAWING 451

City of Newberg LIDA Sizing Form

(Include this form with plan submittal)

Project Title: **A Storage Place - Hancock**

Project Address:

Project Taxlot/ Taxmap#: **Tax Lot 1101, Tax Map 3-2-20AA**

Project Location: **Hancock Street and Elliott Road**

Contact Name/Title/Company: **Leonard A. Rydell, PE, PLS, WRE**

Phone/e-mail: **(503) 538-5700, LARydell@teleport.com**

STEP 1: Determine Impervious Area Requiring Treatment

Total Gross Site Area (acres): **2.8803** Pre. Dev. Impervious Area (ft): **6,275** (X)
Proposed Net New Impervious Area (ft): **95,711** (PA) Post Dev. Impervious Area (ft): **101,986** (Y)
(PA) = (Y) - (X)

STEP 2: Deduct Impervious Area LIDA Credits

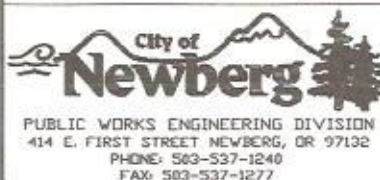
Porous Pavement (sq. ft.): _____ (P)
Green Roof (sq. ft.): _____ (G)
Other Credits as approved (sq. ft.): _____ (O)
Total Credits (sq. ft.): _____ (C)
(C) = (P) + (G) + (O)

Impervious Area
Requiring Treatment (sq. ft.): **95,711** (IA)
(IA) = (PA) - (C)

STEP 3: Size LIDA Facilities for Remaining Impervious Area

	Impervious Area Treated (sq. ft.)	SF, Sizing Factor	LIDA Facility Size (sq. ft.)
Infiltration Planters/ Rain Garden	171,622	0.045	7,723
Flow-through Planter		0.060	
Public Flow-through Planter		0.060	

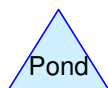
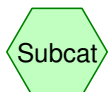
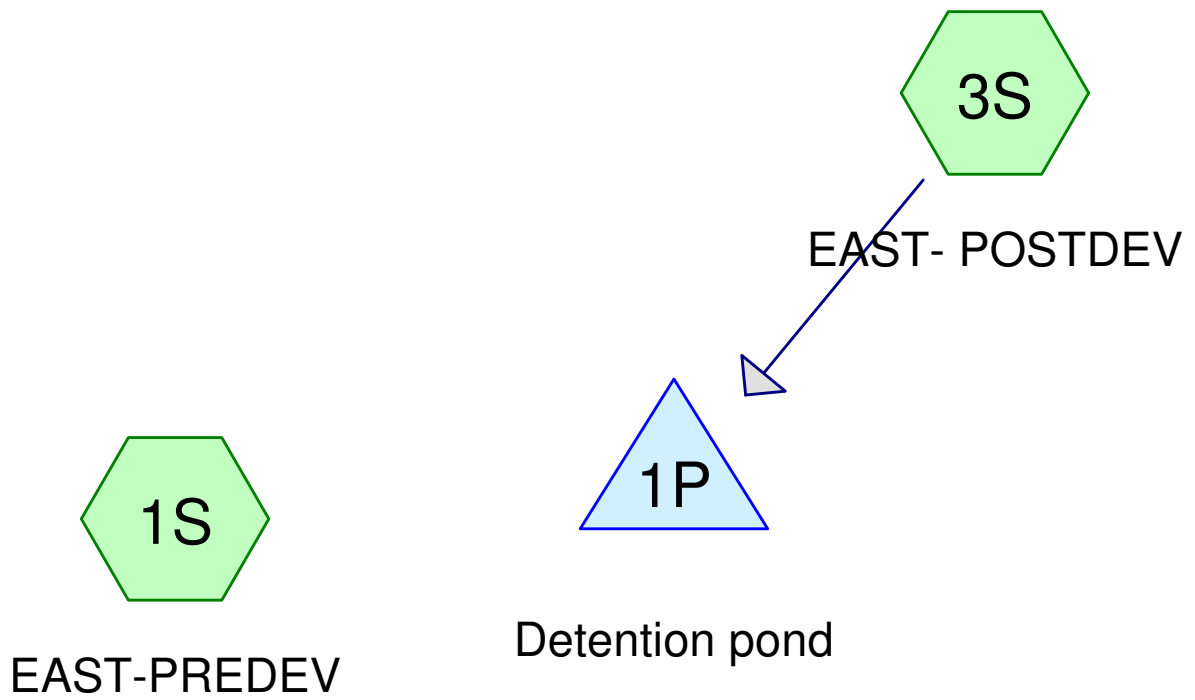
Total Impervious Area
Treated (sq. ft.) **95,711** MUST BE EQUAL TO (IA)



REVISIONS:

LIDA SIZING FORM

SCALE: N.T.S.
DATE: MARCH 2014
APPROVED BY: JAY H.
STANDARD DRAWING 451



1520 HydroCAD Phase I

Prepared by Rydell Engineering

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Page 2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
30,422	87	2300A Soils C/D (3S)
931	87	2301A Soils C/D (3S)
20,627	89	2306A Soils D (3S)
22,129	98	Access Road and Parking (3S)
73,445	87	PASTURE HSG C/D POOR (FILL) (1S)
2,436	87	Pasture/grassland/range, Poor, HSG D (1S)
37,407	89	Pasture/grassland/range, Poor, HSG D (1S)
7,753	89	Rain Gardens (3S)
19,925	98	Storage Building (3S)
11,464	92	Swale and Pond Banks (3S)
226,539	90	TOTAL AREA

1520 HydroCAD Phase I

Prepared by Rydell Engineering

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Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
73,445	HSG C	1S
39,843	HSG D	1S
113,251	Other	3S
226,539		TOTAL AREA

1520 HydroCAD Phase I

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Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	0	0	30,422	30,422	2300A Soils C/D
0	0	0	0	931	931	2301A Soils C/D
0	0	0	0	20,627	20,627	2306A Soils D
0	0	0	0	22,129	22,129	Access Road and Parking
0	0	73,445	0	0	73,445	PASTURE
0	0	0	39,843	0	39,843	Pasture/grassland/range, Poor
0	0	0	0	7,753	7,753	Rain Gardens
0	0	0	0	19,925	19,925	Storage Building
0	0	0	0	11,464	11,464	Swale and Pond Banks
0	0	73,445	39,843	113,251	226,539	TOTAL AREA

1520 HydroCAD Phase I

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Notes Listing (all nodes)

Line#	Node Number	Notes
1	1S	Total Site Drainage Area for Phase I = 2.607 acres

1520 HydroCAD Phase I

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Type IA 24-hr 2-yr Rainfall=2.50"

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Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: EAST-PREDEV

Runoff Area=113,288 sf 0.00% Impervious Runoff Depth=1.38"

Tc=14.6 min CN=88/0 Runoff=0.77 cfs 13,042 cf

Subcatchment 3S: EAST- POSTDEV

Runoff Area=113,251 sf 37.13% Impervious Runoff Depth=1.76"

Tc=5.2 min CN=89/98 Runoff=1.13 cfs 16,589 cf

Pond 1P: Detention pond

Peak Elev=183.04' Storage=1,870 cf Inflow=1.13 cfs 16,589 cf

Discarded=0.00 cfs 6 cf Primary=0.38 cfs 16,583 cf Outflow=0.38 cfs 16,589 cf

Total Runoff Area = 226,539 sf Runoff Volume = 29,631 cf Average Runoff Depth = 1.57"

81.44% Pervious = 184,485 sf 18.56% Impervious = 42,054 sf

1520 HydroCAD Phase I

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Type IA 24-hr 2-yr Rainfall=2.50"

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Summary for Subcatchment 1S: EAST-PREDEV

Total Site Drainage Area for Phase I = 2.607 acres

Runoff = 0.77 cfs @ 8.00 hrs, Volume= 13,042 cf, Depth= 1.38"

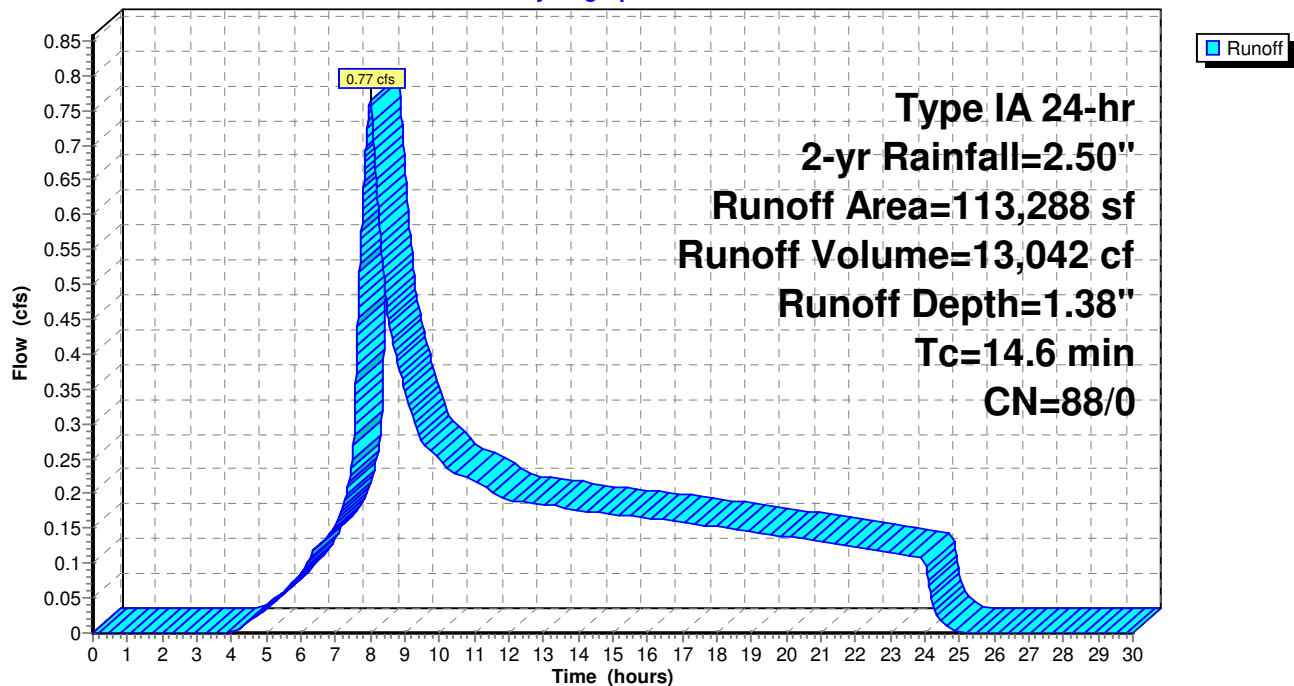
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-yr Rainfall=2.50"

	Area (sf)	CN	Description
*	73,445	87	PASTURE HSG C/D POOR (FILL)
*	2,436	87	Pasture/grassland/range, Poor, HSG D
	37,407	89	Pasture/grassland/range, Poor, HSG D
	113,288	88	Weighted Average
	113,288		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6					Direct Entry, SEE STORMWATER REPORT

Subcatchment 1S: EAST-PREDEV

Hydrograph



1520 HydroCAD Phase I

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Type IA 24-hr 2-yr Rainfall=2.50"

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Summary for Subcatchment 3S: EAST- POSTDEV

Runoff = 1.13 cfs @ 7.92 hrs, Volume= 16,589 cf, Depth= 1.76"

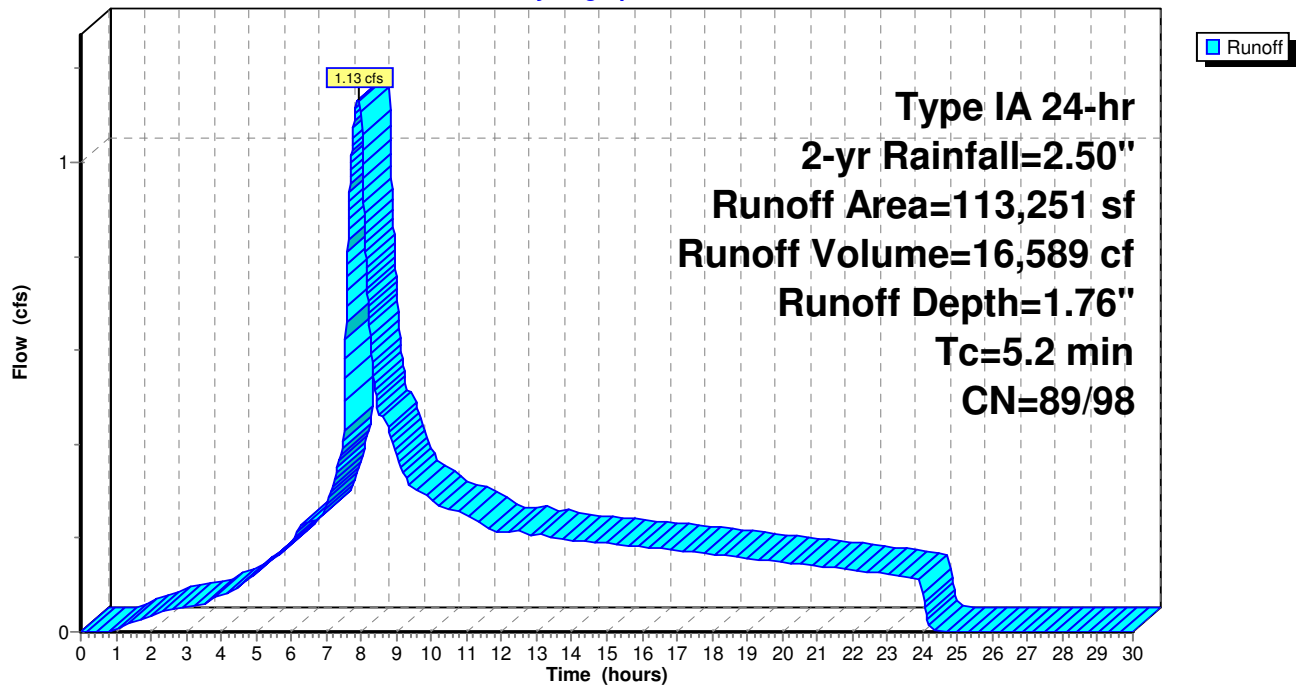
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-yr Rainfall=2.50"

	Area (sf)	CN	Description
*	30,422	87	2300A Soils C/D
*	931	87	2301A Soils C/D
*	20,627	89	2306A Soils D
*	19,925	98	Storage Building
*	22,129	98	Access Road and Parking
*	11,464	92	Swale and Pond Banks
*	7,753	89	Rain Gardens
	113,251	92	Weighted Average
	71,197		62.87% Pervious Area
	42,054		37.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2					Direct Entry, EAST POST DEVELOPMENT

Subcatchment 3S: EAST- POSTDEV

Hydrograph



1520 HydroCAD Phase I

Type IA 24-hr 2-yr Rainfall=2.50"

Prepared by Rydell Engineering

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Summary for Pond 1P: Detention pond

Inflow Area = 113,251 sf, 37.13% Impervious, Inflow Depth = 1.76" for 2-yr event
 Inflow = 1.13 cfs @ 7.92 hrs, Volume= 16,589 cf
 Outflow = 0.38 cfs @ 8.99 hrs, Volume= 16,589 cf, Atten= 66%, Lag= 64.3 min
 Discarded = 0.00 cfs @ 8.99 hrs, Volume= 6 cf
 Primary = 0.38 cfs @ 8.99 hrs, Volume= 16,583 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 183.04' @ 8.99 hrs Surf.Area= 4,850 sf Storage= 1,870 cf

Plug-Flow detention time= 26.7 min calculated for 16,583 cf (100% of inflow)

Center-of-Mass det. time= 26.6 min (753.0 - 726.4)

Volume	Invert	Avail.Storage	Storage Description
#1	182.64'	5,553 cf	Custom Stage Data (Irregular) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
182.64	4,433	499.0	0	0	4,433
183.00	4,807	514.0	1,663	1,663	5,656
183.50	5,321	532.0	2,531	4,194	7,177
183.75	5,553	539.0	1,359	5,553	7,788

Device	Routing	Invert	Outlet Devices
#1	Primary	181.75'	3.7" Vert. Orifice/Grate 2-YR C= 0.600
#2	Primary	183.05'	29.5" W x 8.0" H Vert. Orifice/Grate 25-YR C= 0.600
#3	Discarded	182.64'	0.001 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.00 cfs @ 8.99 hrs HW=183.04' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.38 cfs @ 8.99 hrs HW=183.04' (Free Discharge)
 ↑ **1=Orifice/Grate 2-YR** (Orifice Controls 0.38 cfs @ 5.14 fps)
 ↓ **2=Orifice/Grate 25-YR** (Controls 0.00 cfs)

1520 HydroCAD Phase I

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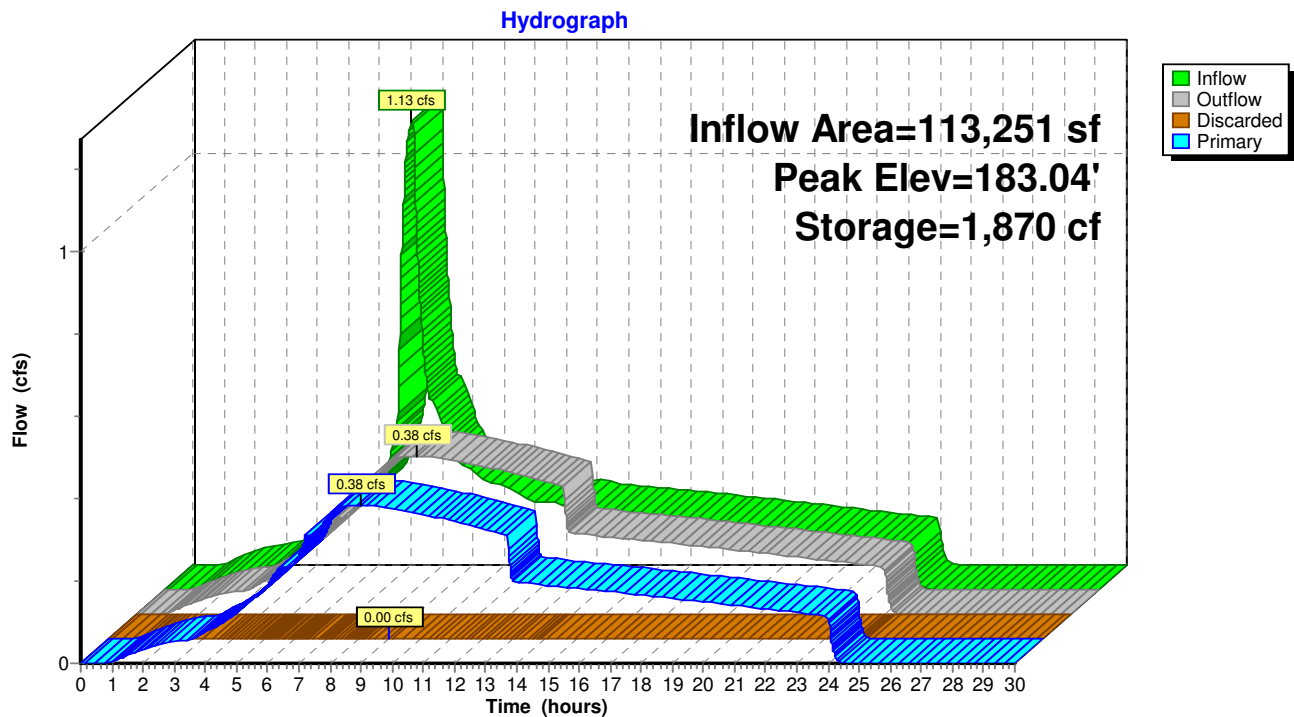
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Type IA 24-hr 2-yr Rainfall=2.50"

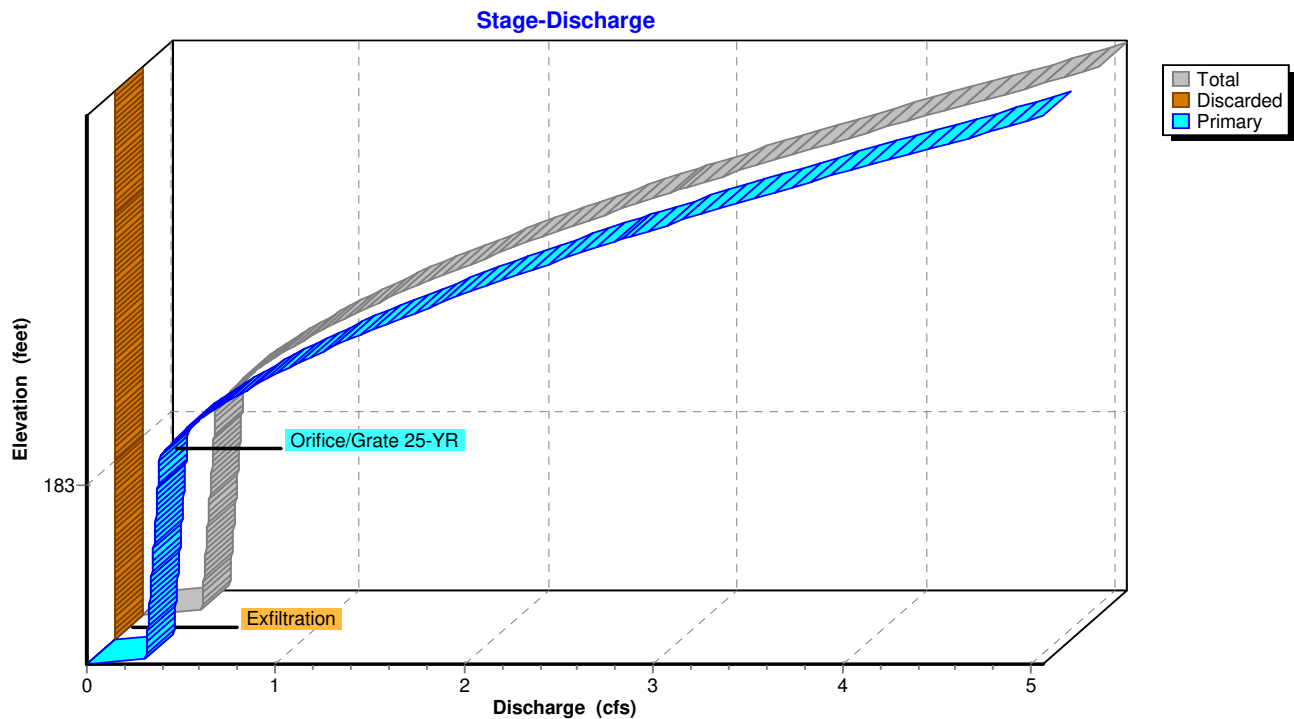
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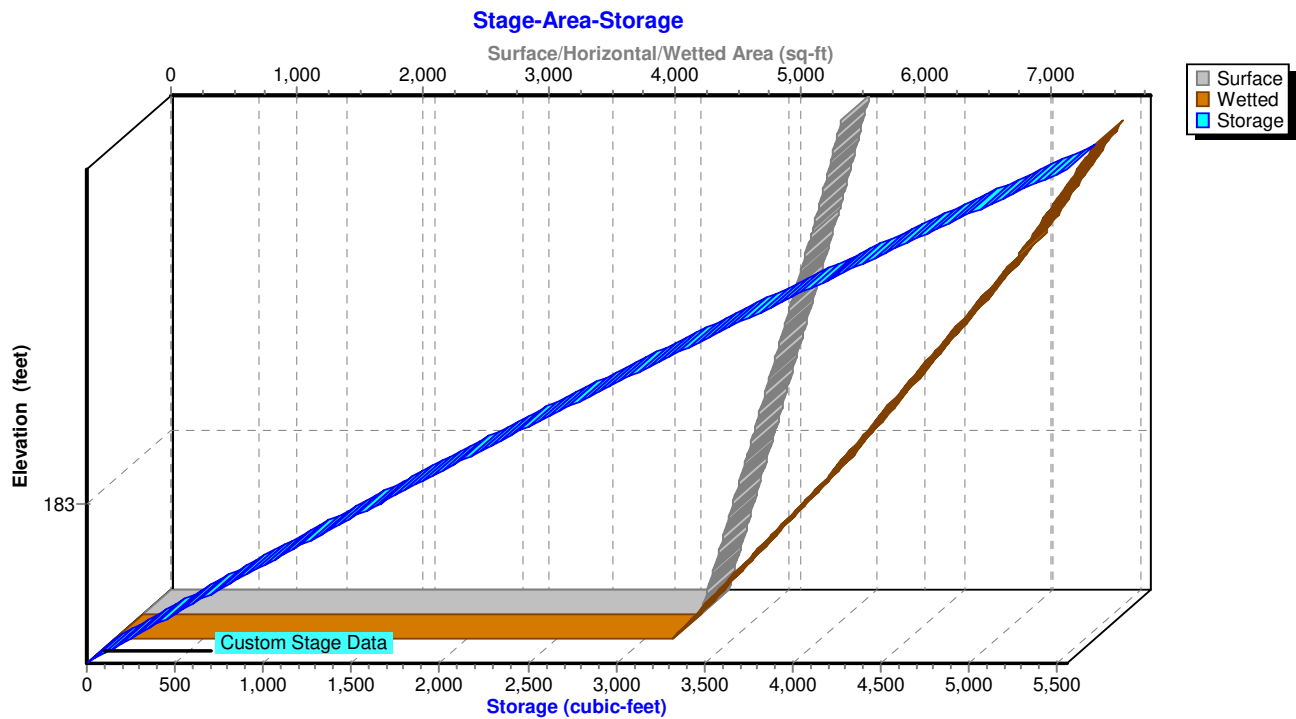
Pond 1P: Detention pond



Pond 1P: Detention pond



Pond 1P: Detention pond



1520 HydroCAD Phase I

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Type IA 24-hr 10-yr Rainfall=3.50"

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Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: EAST-PREDEV

Runoff Area=113,288 sf 0.00% Impervious Runoff Depth=2.27"

Tc=14.6 min CN=88/0 Runoff=1.32 cfs 21,418 cf

Subcatchment 3S: EAST- POSTDEV

Runoff Area=113,251 sf 37.13% Impervious Runoff Depth=2.69"

Tc=5.2 min CN=89/98 Runoff=1.76 cfs 25,433 cf

Pond 1P: Detention pond

Peak Elev=183.24' Storage=2,845 cf Inflow=1.76 cfs 25,433 cf

Discarded=0.00 cfs 8 cf Primary=1.07 cfs 25,425 cf Outflow=1.07 cfs 25,433 cf

Total Runoff Area = 226,539 sf Runoff Volume = 46,850 cf Average Runoff Depth = 2.48"

81.44% Pervious = 184,485 sf 18.56% Impervious = 42,054 sf

1520 HydroCAD Phase I

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Type IA 24-hr 10-yr Rainfall=3.50"

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Summary for Subcatchment 1S: EAST-PREDEV

Total Site Drainage Area for Phase I = 2.607 acres

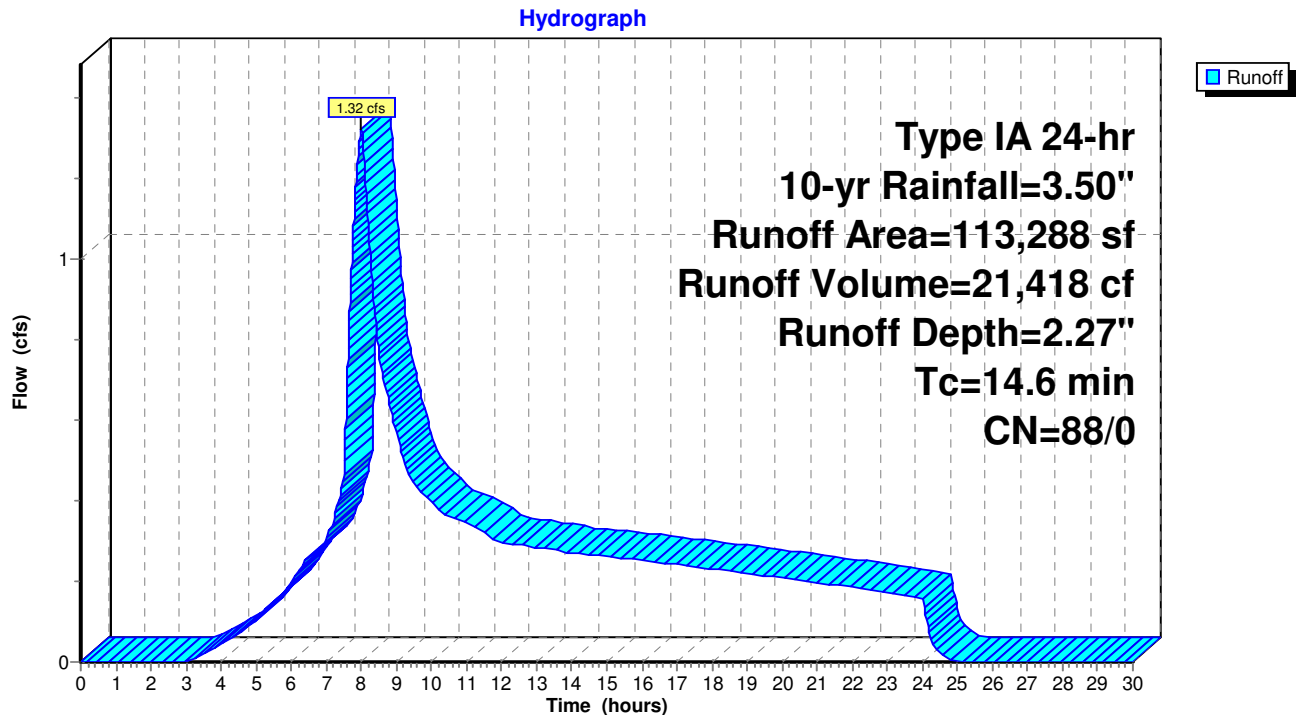
Runoff = 1.32 cfs @ 8.00 hrs, Volume= 21,418 cf, Depth= 2.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-yr Rainfall=3.50"

	Area (sf)	CN	Description
*	73,445	87	PASTURE HSG C/D POOR (FILL)
*	2,436	87	Pasture/grassland/range, Poor, HSG D
	37,407	89	Pasture/grassland/range, Poor, HSG D
	113,288	88	Weighted Average
	113,288		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6					Direct Entry, SEE STORMWATER REPORT

Subcatchment 1S: EAST-PREDEV



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Type IA 24-hr 10-yr Rainfall=3.50"

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Summary for Subcatchment 3S: EAST- POSTDEV

Runoff = 1.76 cfs @ 7.91 hrs, Volume= 25,433 cf, Depth= 2.69"

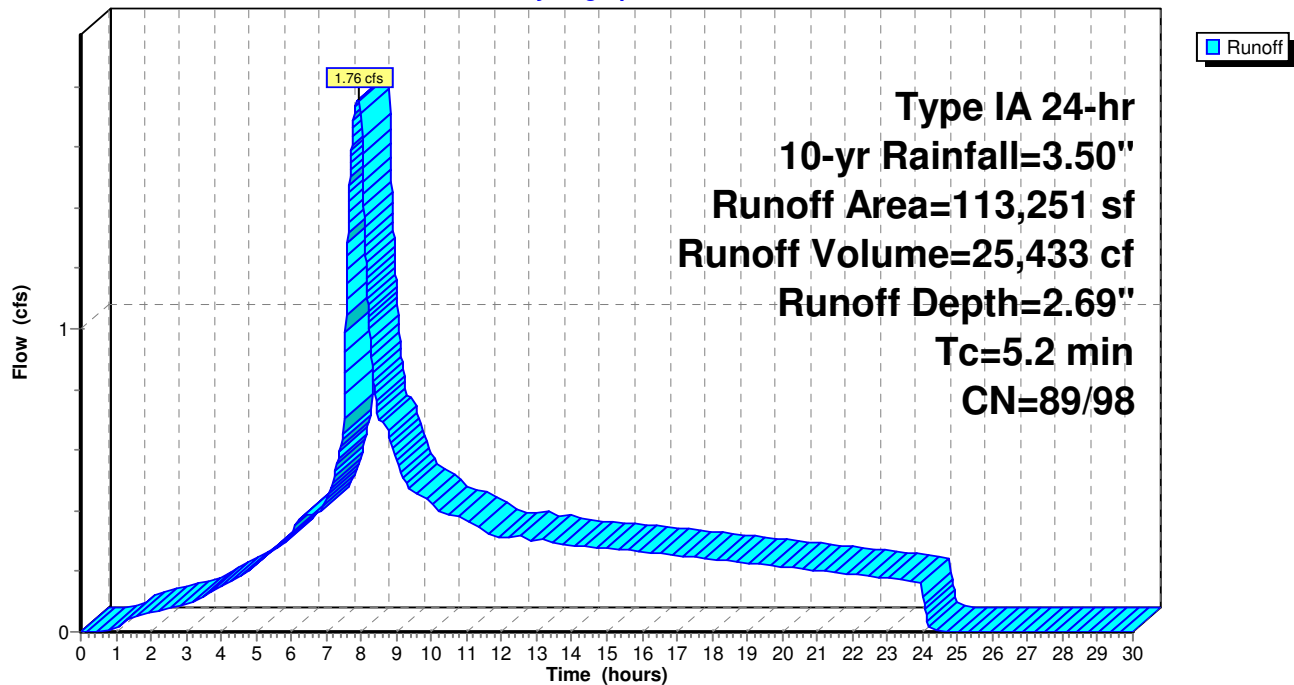
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-yr Rainfall=3.50"

	Area (sf)	CN	Description
*	30,422	87	2300A Soils C/D
*	931	87	2301A Soils C/D
*	20,627	89	2306A Soils D
*	19,925	98	Storage Building
*	22,129	98	Access Road and Parking
*	11,464	92	Swale and Pond Banks
*	7,753	89	Rain Gardens
	113,251	92	Weighted Average
	71,197		62.87% Pervious Area
	42,054		37.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2					Direct Entry, EAST POST DEVELOPMENT

Subcatchment 3S: EAST- POSTDEV

Hydrograph



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Type IA 24-hr 10-yr Rainfall=3.50"

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Summary for Pond 1P: Detention pond

Inflow Area = 113,251 sf, 37.13% Impervious, Inflow Depth = 2.69" for 10-yr event
 Inflow = 1.76 cfs @ 7.91 hrs, Volume= 25,433 cf
 Outflow = 1.07 cfs @ 8.20 hrs, Volume= 25,433 cf, Atten= 39%, Lag= 17.4 min
 Discarded = 0.00 cfs @ 8.20 hrs, Volume= 8 cf
 Primary = 1.07 cfs @ 8.20 hrs, Volume= 25,425 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 183.24' @ 8.20 hrs Surf.Area= 5,050 sf Storage= 2,845 cf

Plug-Flow detention time= 39.1 min calculated for 25,424 cf (100% of inflow)
 Center-of-Mass det. time= 39.1 min (749.1 - 710.0)

Volume	Invert	Avail.Storage	Storage Description
#1	182.64'	5,553 cf	Custom Stage Data (Irregular) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
182.64	4,433	499.0	0	0	4,433
183.00	4,807	514.0	1,663	1,663	5,656
183.50	5,321	532.0	2,531	4,194	7,177
183.75	5,553	539.0	1,359	5,553	7,788

Device	Routing	Invert	Outlet Devices
#1	Primary	181.75'	3.7" Vert. Orifice/Grate 2-YR C= 0.600
#2	Primary	183.05'	29.5" W x 8.0" H Vert. Orifice/Grate 25-YR C= 0.600
#3	Discarded	182.64'	0.001 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.00 cfs @ 8.20 hrs HW=183.24' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=1.07 cfs @ 8.20 hrs HW=183.24' (Free Discharge)
 ↑ **1=Orifice/Grate 2-YR** (Orifice Controls 0.42 cfs @ 5.56 fps)
 ↓ **2=Orifice/Grate 25-YR** (Orifice Controls 0.65 cfs @ 1.40 fps)

1520 HydroCAD Phase I

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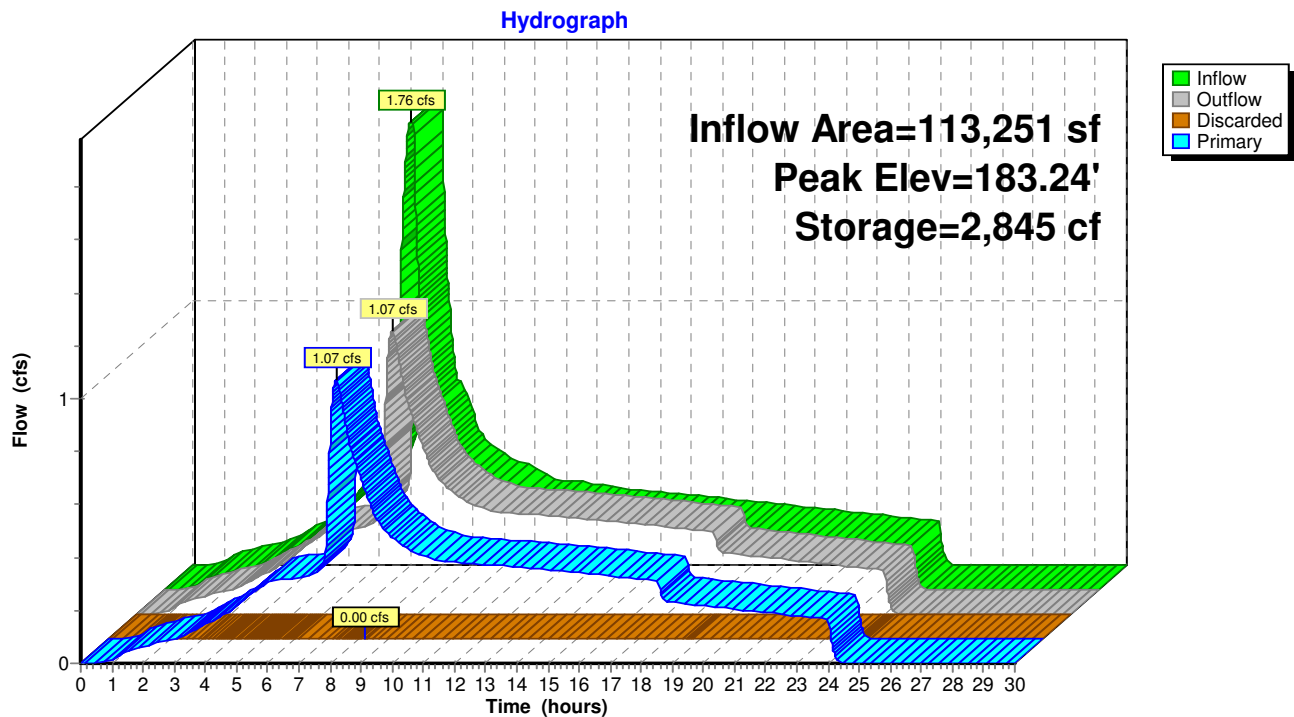
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Type IA 24-hr 10-yr Rainfall=3.50"

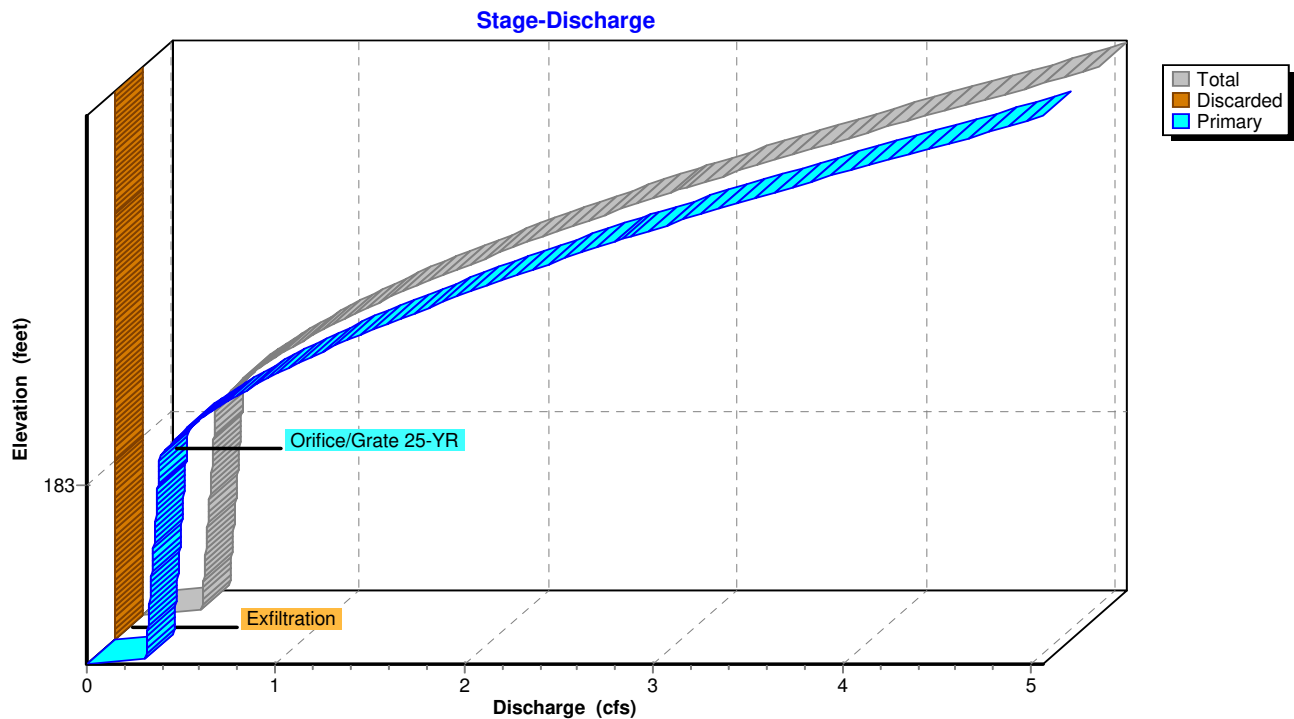
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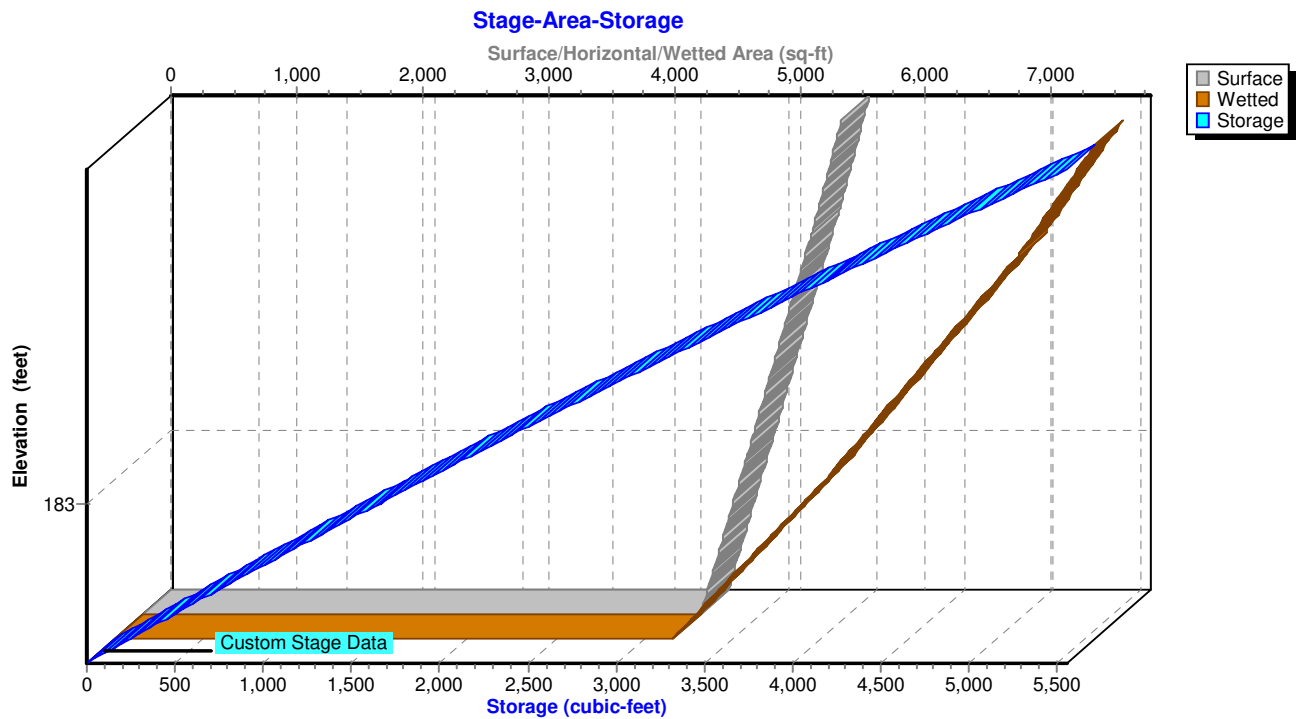
Pond 1P: Detention pond



Pond 1P: Detention pond



Pond 1P: Detention pond



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Type IA 24-hr 25-yr Rainfall=4.00"

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Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: EAST-PREDEV

Runoff Area=113,288 sf 0.00% Impervious Runoff Depth=2.73"

Tc=14.6 min CN=88/0 Runoff=1.61 cfs 25,763 cf

Subcatchment 3S: EAST- POSTDEV

Runoff Area=113,251 sf 37.13% Impervious Runoff Depth=3.17"

Tc=5.2 min CN=89/98 Runoff=2.08 cfs 29,944 cf

Pond 1P: Detention pond

Peak Elev=183.32' Storage=3,250 cf Inflow=2.08 cfs 29,944 cf

Discarded=0.00 cfs 9 cf Primary=1.53 cfs 29,936 cf Outflow=1.53 cfs 29,944 cf

Total Runoff Area = 226,539 sf Runoff Volume = 55,707 cf Average Runoff Depth = 2.95"

81.44% Pervious = 184,485 sf 18.56% Impervious = 42,054 sf

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Type IA 24-hr 25-yr Rainfall=4.00"

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Summary for Subcatchment 1S: EAST-PREDEV

Total Site Drainage Area for Phase I = 2.607 acres

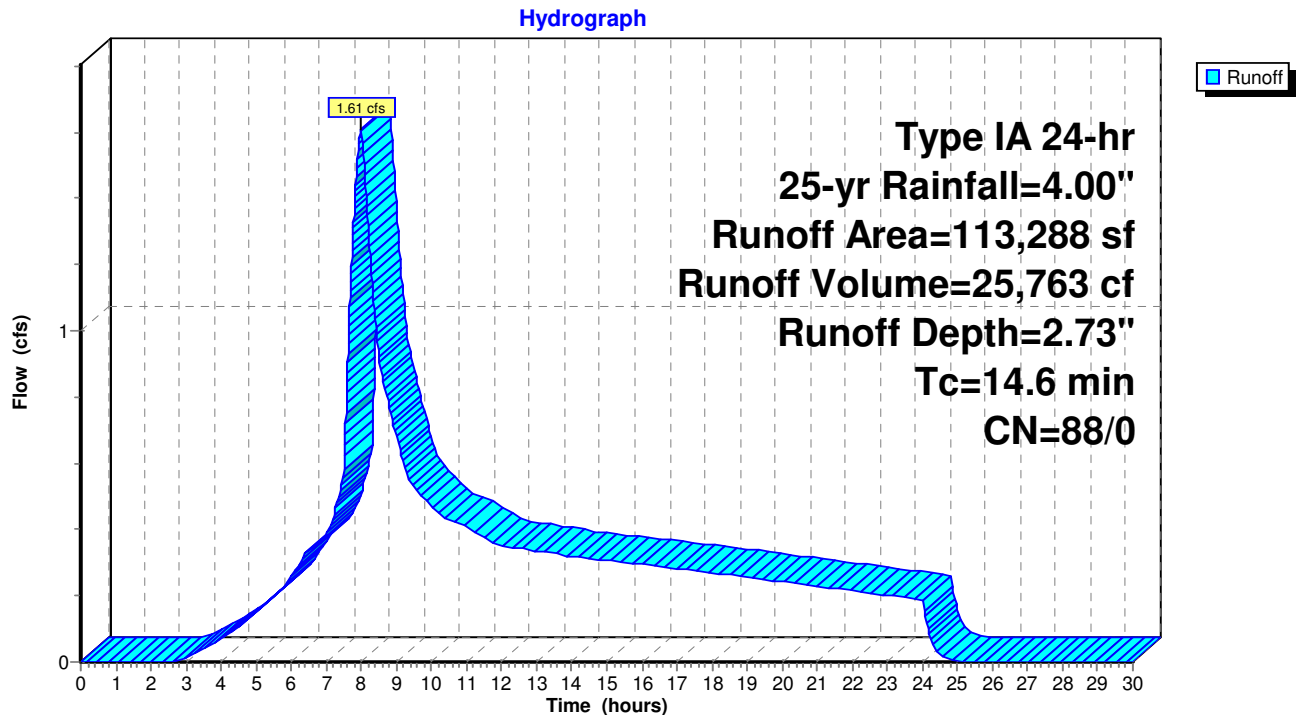
Runoff = 1.61 cfs @ 8.00 hrs, Volume= 25,763 cf, Depth= 2.73"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-yr Rainfall=4.00"

	Area (sf)	CN	Description
*	73,445	87	PASTURE HSG C/D POOR (FILL)
*	2,436	87	Pasture/grassland/range, Poor, HSG D
	37,407	89	Pasture/grassland/range, Poor, HSG D
	113,288	88	Weighted Average
	113,288		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6					Direct Entry, SEE STORMWATER REPORT

Subcatchment 1S: EAST-PREDEV



1520 HydroCAD Phase I

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Type IA 24-hr 25-yr Rainfall=4.00"

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Summary for Subcatchment 3S: EAST- POSTDEV

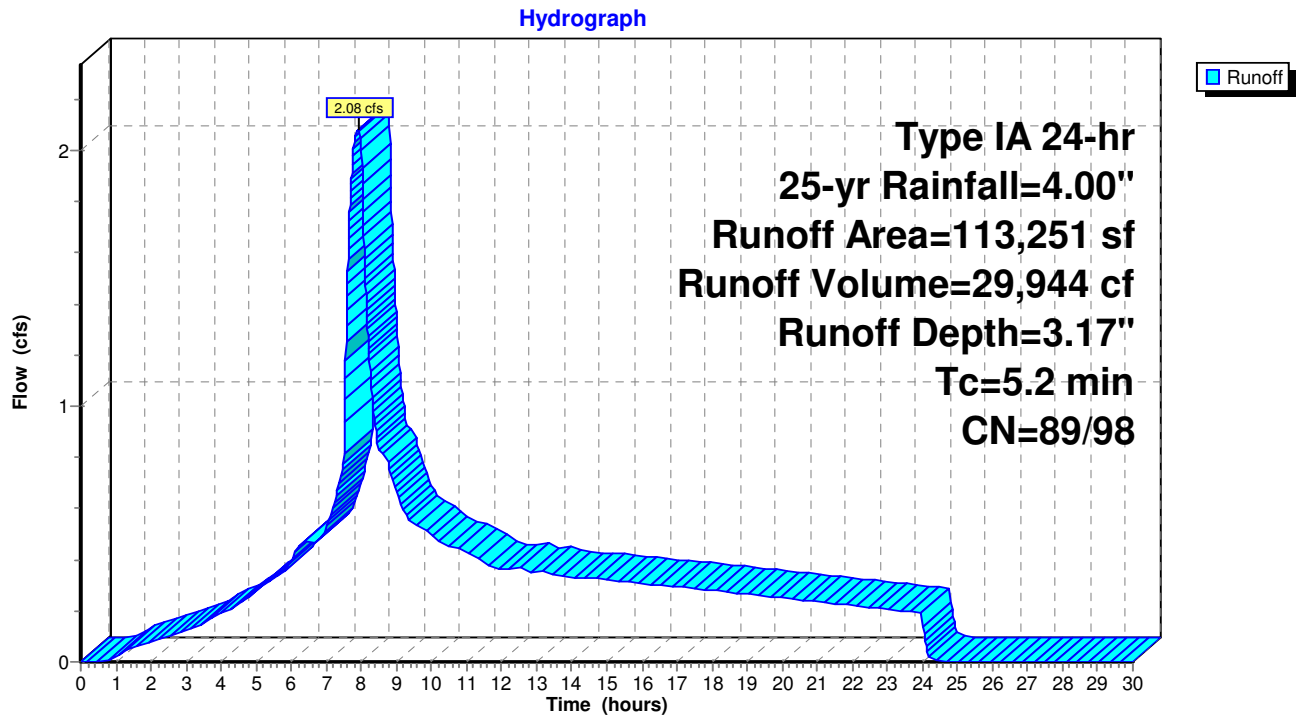
Runoff = 2.08 cfs @ 7.90 hrs, Volume= 29,944 cf, Depth= 3.17"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-yr Rainfall=4.00"

	Area (sf)	CN	Description
*	30,422	87	2300A Soils C/D
*	931	87	2301A Soils C/D
*	20,627	89	2306A Soils D
*	19,925	98	Storage Building
*	22,129	98	Access Road and Parking
*	11,464	92	Swale and Pond Banks
*	7,753	89	Rain Gardens
	113,251	92	Weighted Average
	71,197		62.87% Pervious Area
	42,054		37.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2					Direct Entry, EAST POST DEVELOPMENT

Subcatchment 3S: EAST- POSTDEV



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Type IA 24-hr 25-yr Rainfall=4.00"

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Summary for Pond 1P: Detention pond

Inflow Area = 113,251 sf, 37.13% Impervious, Inflow Depth = 3.17" for 25-yr event
 Inflow = 2.08 cfs @ 7.90 hrs, Volume= 29,944 cf
 Outflow = 1.53 cfs @ 8.10 hrs, Volume= 29,944 cf, Atten= 27%, Lag= 11.9 min
 Discarded = 0.00 cfs @ 8.10 hrs, Volume= 9 cf
 Primary = 1.53 cfs @ 8.10 hrs, Volume= 29,936 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 183.32' @ 8.10 hrs Surf.Area= 5,132 sf Storage= 3,250 cf

Plug-Flow detention time= 44.8 min calculated for 29,944 cf (100% of inflow)

Center-of-Mass det. time= 44.8 min (748.9 - 704.0)

Volume	Invert	Avail.Storage	Storage Description
#1	182.64'	5,553 cf	Custom Stage Data (Irregular) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
182.64	4,433	499.0	0	0	4,433
183.00	4,807	514.0	1,663	1,663	5,656
183.50	5,321	532.0	2,531	4,194	7,177
183.75	5,553	539.0	1,359	5,553	7,788

Device	Routing	Invert	Outlet Devices
#1	Primary	181.75'	3.7" Vert. Orifice/Grate 2-YR C= 0.600
#2	Primary	183.05'	29.5" W x 8.0" H Vert. Orifice/Grate 25-YR C= 0.600
#3	Discarded	182.64'	0.001 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.00 cfs @ 8.10 hrs HW=183.32' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=1.53 cfs @ 8.10 hrs HW=183.32' (Free Discharge)
 ↑ **1=Orifice/Grate 2-YR** (Orifice Controls 0.43 cfs @ 5.73 fps)
 ↓ **2=Orifice/Grate 25-YR** (Orifice Controls 1.10 cfs @ 1.67 fps)

1520 HydroCAD Phase I

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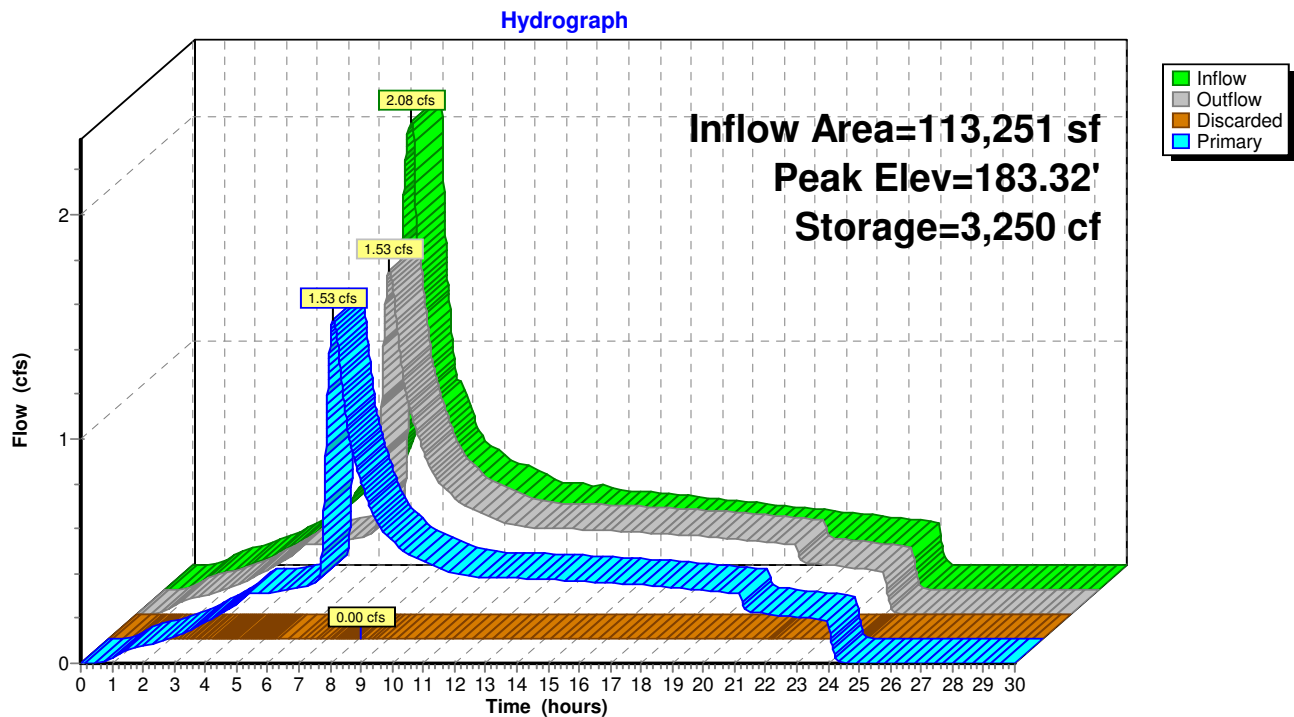
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Type IA 24-hr 25-yr Rainfall=4.00"

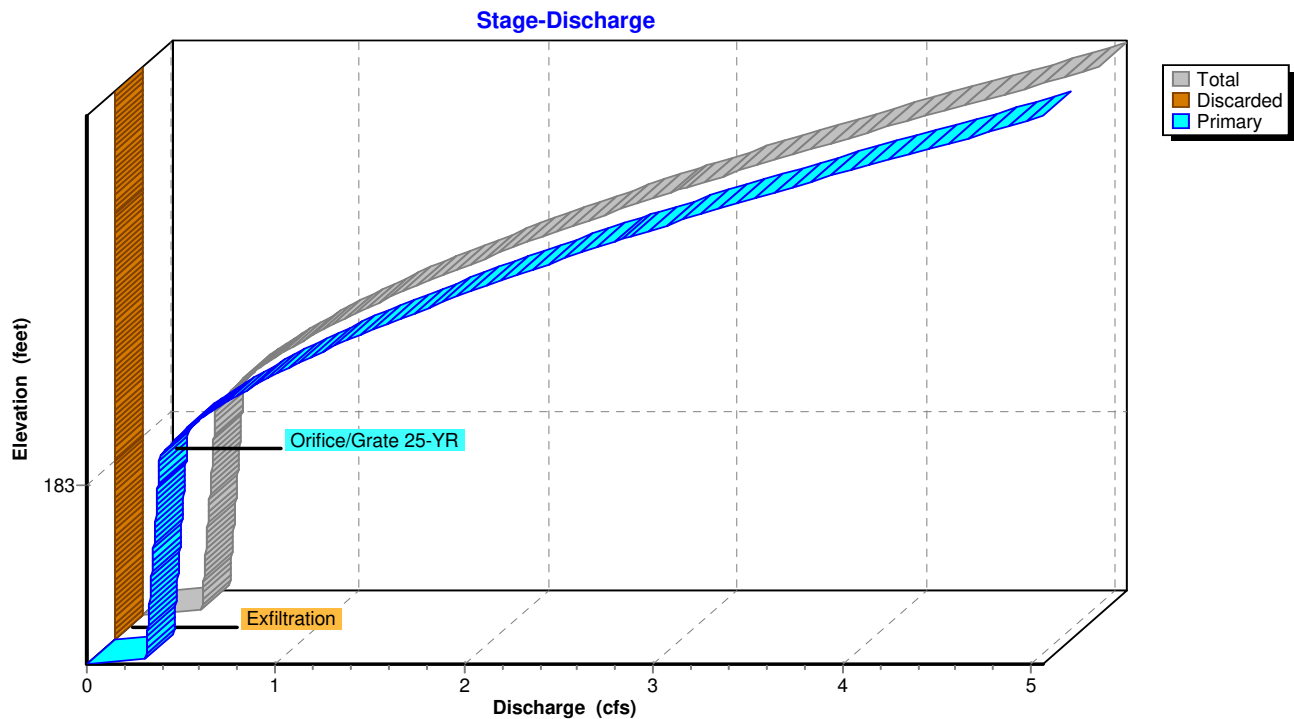
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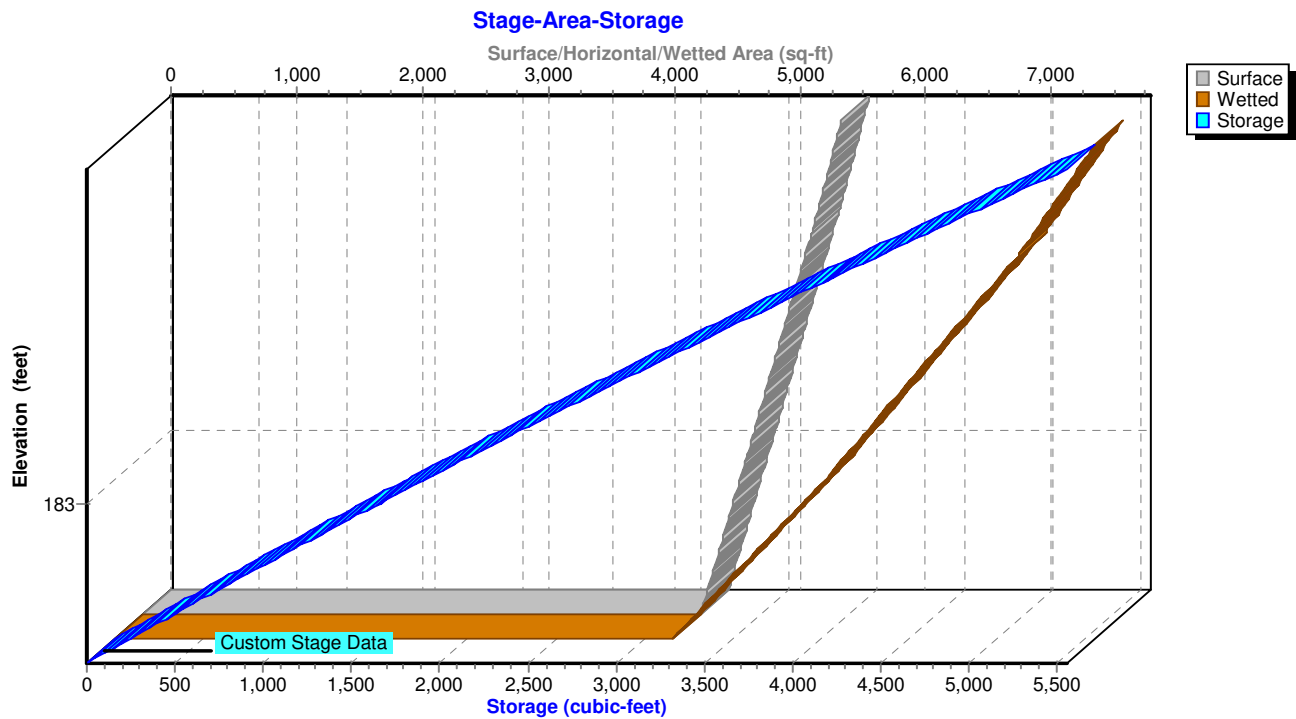
Pond 1P: Detention pond

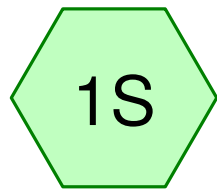


Pond 1P: Detention pond

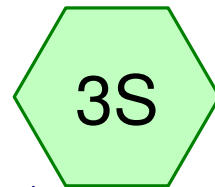


Pond 1P: Detention pond

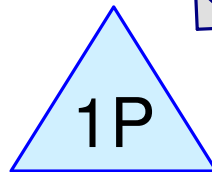
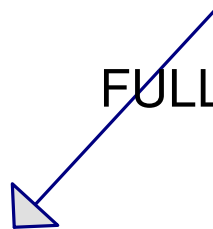




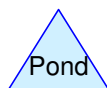
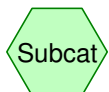
SITE-PREDEV



FULL- POSTDEV



Detention pond



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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
3,468	87	2300A Soils C/D (3S)
613	87	2301A Soils C/D (3S)
410	89	2306A Soils D (3S)
21,901	98	Access Road and Parking (3S)
16,031	98	Center Future Access (3S)
14,625	98	Center Future Building (3S)
7,200	98	East Future Building (3S)
6,168	98	Fire Access Driveway (1S)
10,145	92	Landscape Side Slopes (3S)
73,445	87	PASTURE HSG C/D POOR (FILL) (1S)
2,436	87	Pasture/grassland/range, Poor, HSG D (1S)
37,407	89	Pasture/grassland/range, Poor, HSG D (1S)
6,008	87	Pasture/grassland/range/Poor,HSG (1S)
19,925	98	Phase I Storage Building (3S)
1,120	92	Pond Banks (3S)
7,723	89	Rain Gardens (3S)
13,553	98	West Future Access (3S)
8,750	98	West Future Building (3S)
250,928	92	TOTAL AREA

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Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
73,445	HSG C	1S
39,843	HSG D	1S
137,640	Other	1S, 3S
250,928		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	0	0	3,468	3,468	2300A Soils C/D
0	0	0	0	613	613	2301A Soils C/D
0	0	0	0	410	410	2306A Soils D
0	0	0	0	21,901	21,901	Access Road and Parking
0	0	0	0	16,031	16,031	Center Future Access
0	0	0	0	14,625	14,625	Center Future Building
0	0	0	0	7,200	7,200	East Future Building
0	0	0	0	6,168	6,168	Fire Access Driveway
0	0	0	0	10,145	10,145	Landscape Side Slopes
0	0	73,445	0	0	73,445	PASTURE
0	0	0	39,843	0	39,843	Pasture/grasslan d/range, Poor
0	0	0	0	6,008	6,008	Pasture/grasslan d/range/Poor
0	0	0	0	19,925	19,925	Phase I Storage Building
0	0	0	0	1,120	1,120	Pond Banks
0	0	0	0	7,723	7,723	Rain Gardens
0	0	0	0	13,553	13,553	West Future Access
0	0	0	0	8,750	8,750	West Future Building
0	0	73,445	39,843	137,640	250,928	TOTAL AREA

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Notes Listing (all nodes)

Line#	Node Number	Notes
1	1S	Total Site Drainage Area for Phase I = 2.607 acres

1520 HydroCAD Full Dev*Type IA 24-hr 2-yr Rainfall=2.50"*

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Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: SITE-PREDEV

Runoff Area=125,464 sf 4.92% Impervious Runoff Depth=1.43"

Tc=14.6 min CN=88/98 Runoff=0.88 cfs 14,901 cf

Subcatchment 3S: FULL- POSTDEV

Runoff Area=125,464 sf 81.29% Impervious Runoff Depth=2.13"

Tc=5.2 min CN=90/98 Runoff=1.55 cfs 22,294 cf

Pond 1P: Detention pond

Peak Elev=183.36' Storage=3,450 cf Inflow=1.55 cfs 22,294 cf

Discarded=0.00 cfs 8 cf Primary=0.43 cfs 22,286 cf Outflow=0.43 cfs 22,294 cf

Total Runoff Area = 250,928 sf Runoff Volume = 37,195 cf Average Runoff Depth = 1.78"**56.90% Pervious = 142,775 sf 43.10% Impervious = 108,153 sf**

Summary for Subcatchment 1S: SITE-PREDEV

Total Site Drainage Area for Phase I = 2.607 acres

Runoff = 0.88 cfs @ 8.00 hrs, Volume= 14,901 cf, Depth= 1.43"

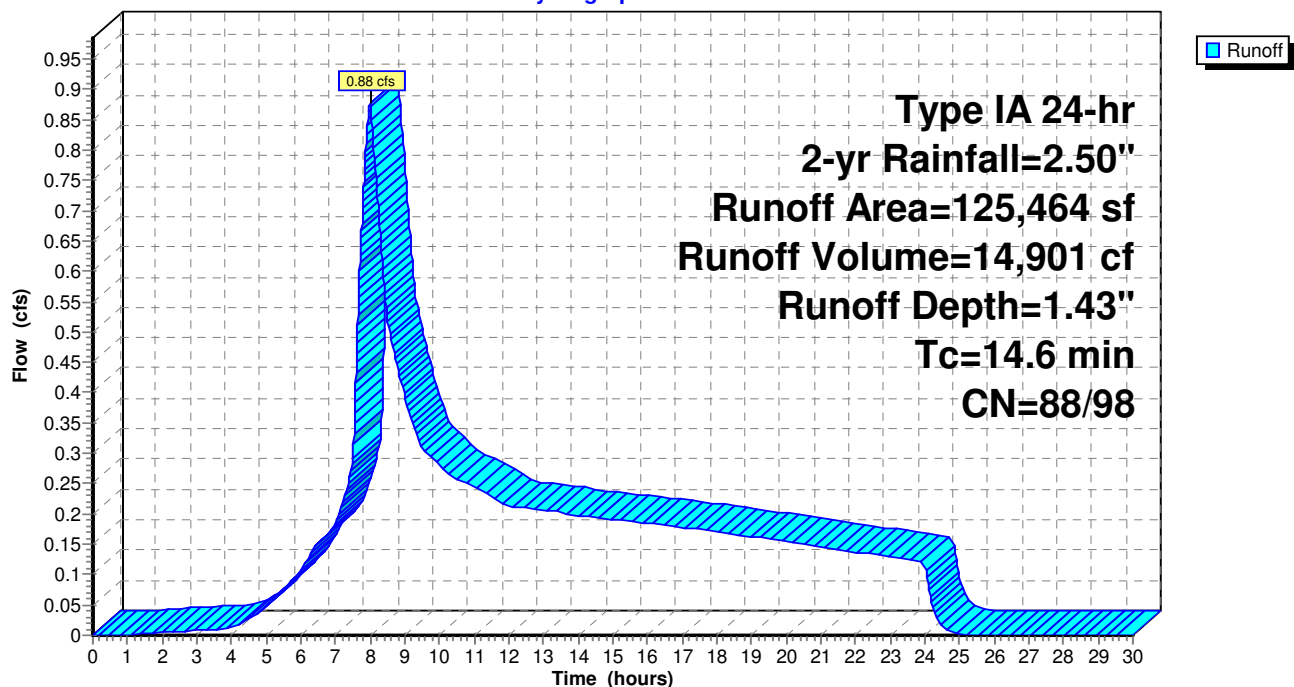
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-yr Rainfall=2.50"

	Area (sf)	CN	Description
*	73,445	87	PASTURE HSG C/D POOR (FILL)
*	2,436	87	Pasture/grassland/range, Poor, HSG D
	37,407	89	Pasture/grassland/range, Poor, HSG D
*	6,168	98	Fire Access Driveway
*	6,008	87	Pasture/grassland/range/Poor,HSG
	125,464	88	Weighted Average
	119,296		95.08% Pervious Area
	6,168		4.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6					Direct Entry, SEE STORMWATER REPORT

Subcatchment 1S: SITE-PREDEV

Hydrograph



1520 HydroCAD Full Dev

Type IA 24-hr 2-yr Rainfall=2.50"

Prepared by Rydell Engineering

Printed 9/7/2016

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Summary for Subcatchment 3S: FULL- POSTDEV

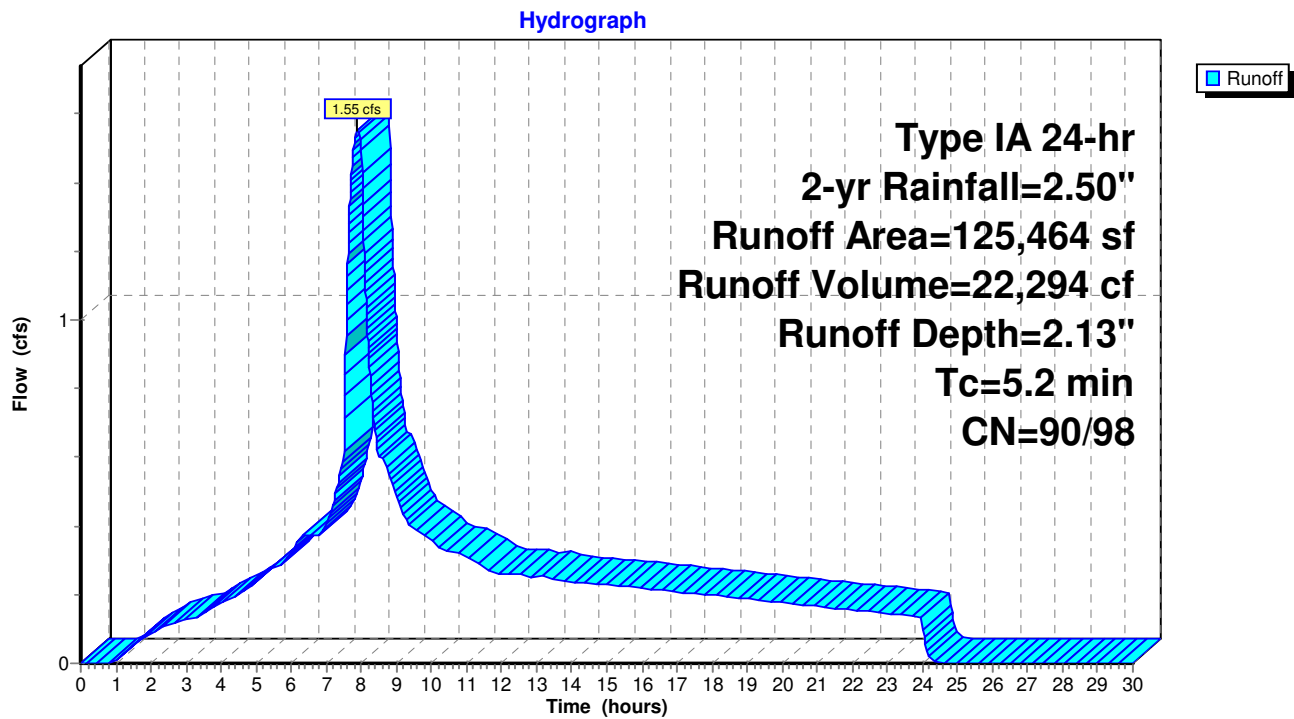
Runoff = 1.55 cfs @ 7.89 hrs, Volume= 22,294 cf, Depth= 2.13"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-yr Rainfall=2.50"

Area (sf)	CN	Description
* 3,468	87	2300A Soils C/D
* 613	87	2301A Soils C/D
* 410	89	2306A Soils D
* 19,925	98	Phase I Storage Building
* 21,901	98	Access Road and Parking
* 10,145	92	Landscape Side Slopes
* 7,723	89	Rain Gardens
* 1,120	92	Pond Banks
* 16,031	98	Center Future Access
* 13,553	98	West Future Access
* 7,200	98	East Future Building
* 14,625	98	Center Future Building
* 8,750	98	West Future Building
125,464	97	Weighted Average
23,479		18.71% Pervious Area
101,985		81.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2					Direct Entry, EAST POST DEVELOPMENT

Subcatchment 3S: FULL- POSTDEV



Summary for Pond 1P: Detention pond

Inflow Area = 125,464 sf, 81.29% Impervious, Inflow Depth = 2.13" for 2-yr event
 Inflow = 1.55 cfs @ 7.89 hrs, Volume= 22,294 cf
 Outflow = 0.43 cfs @ 9.21 hrs, Volume= 22,294 cf, Atten= 72%, Lag= 78.8 min
 Discarded = 0.00 cfs @ 9.21 hrs, Volume= 8 cf
 Primary = 0.43 cfs @ 9.21 hrs, Volume= 22,286 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 183.36' @ 9.21 hrs Surf.Area= 5,173 sf Storage= 3,450 cf

Plug-Flow detention time= 55.1 min calculated for 22,287 cf (100% of inflow)

Center-of-Mass det. time= 55.1 min (740.5 - 685.4)

Volume	Invert	Avail.Storage	Storage Description
#1	182.64'	5,553 cf	Custom Stage Data (Irregular) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
182.64	4,433	499.0	0	0	4,433
183.00	4,807	514.0	1,663	1,663	5,656
183.50	5,321	532.0	2,531	4,194	7,177
183.75	5,553	539.0	1,359	5,553	7,788

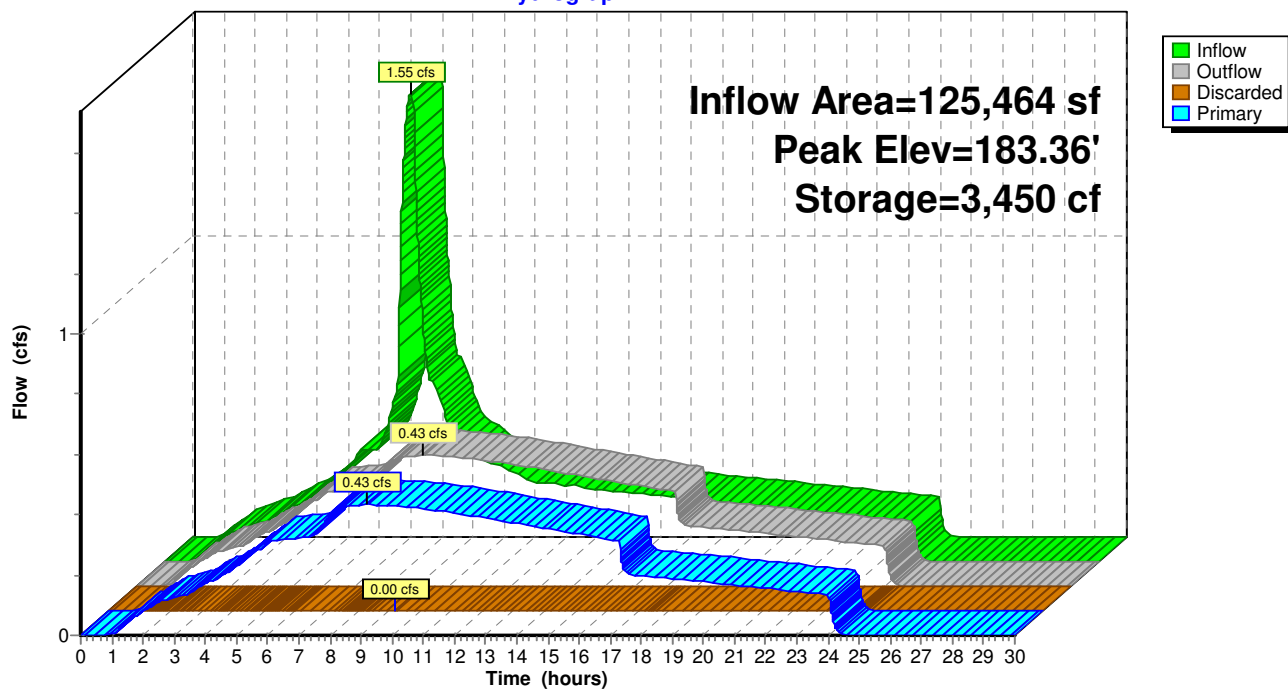
Device	Routing	Invert	Outlet Devices
#1	Primary	181.75'	3.7" Vert. Orifice/Grate 2-YR C= 0.600
#2	Primary	183.44'	29.5" W x 12.0" H Vert. Orifice/Grate -DITCH INLET C= 0.600
#3	Discarded	182.64'	0.001 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.00 cfs @ 9.21 hrs HW=183.36' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.43 cfs @ 9.21 hrs HW=183.36' (Free Discharge)
 ↑ **1=Orifice/Grate 2-YR** (Orifice Controls 0.43 cfs @ 5.81 fps)
 ↓ **2=Orifice/Grate -DITCH INLET** (Controls 0.00 cfs)

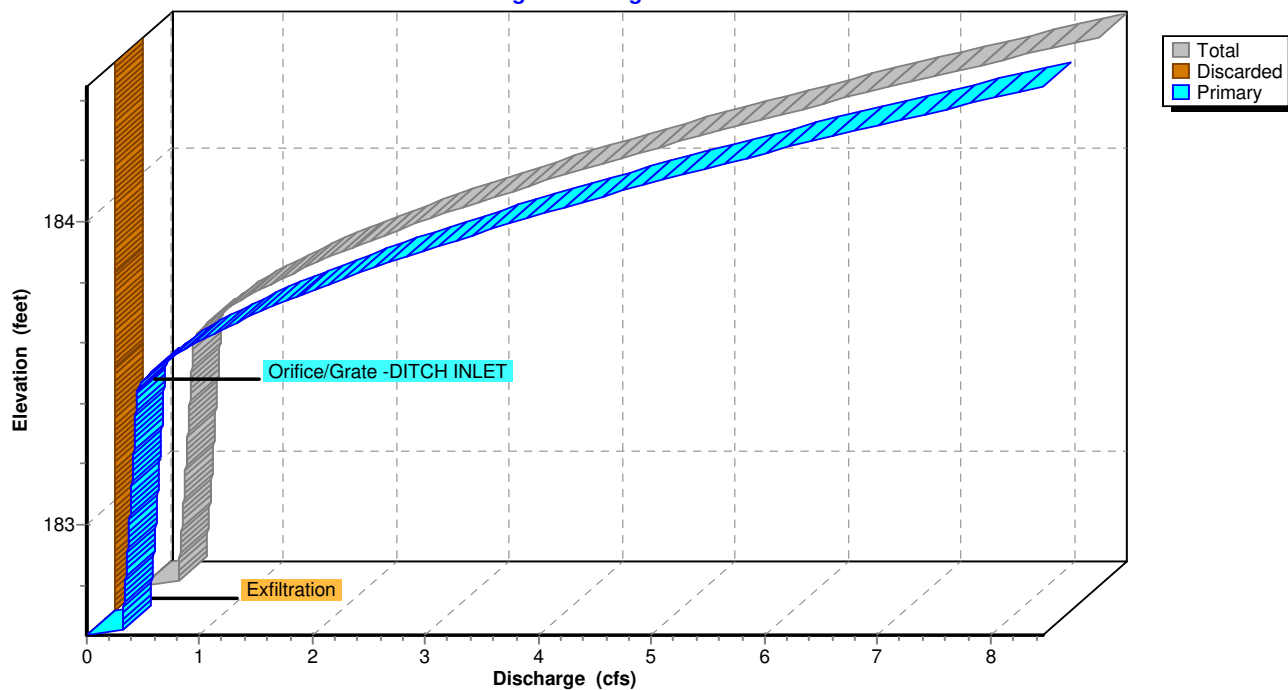
Pond 1P: Detention pond

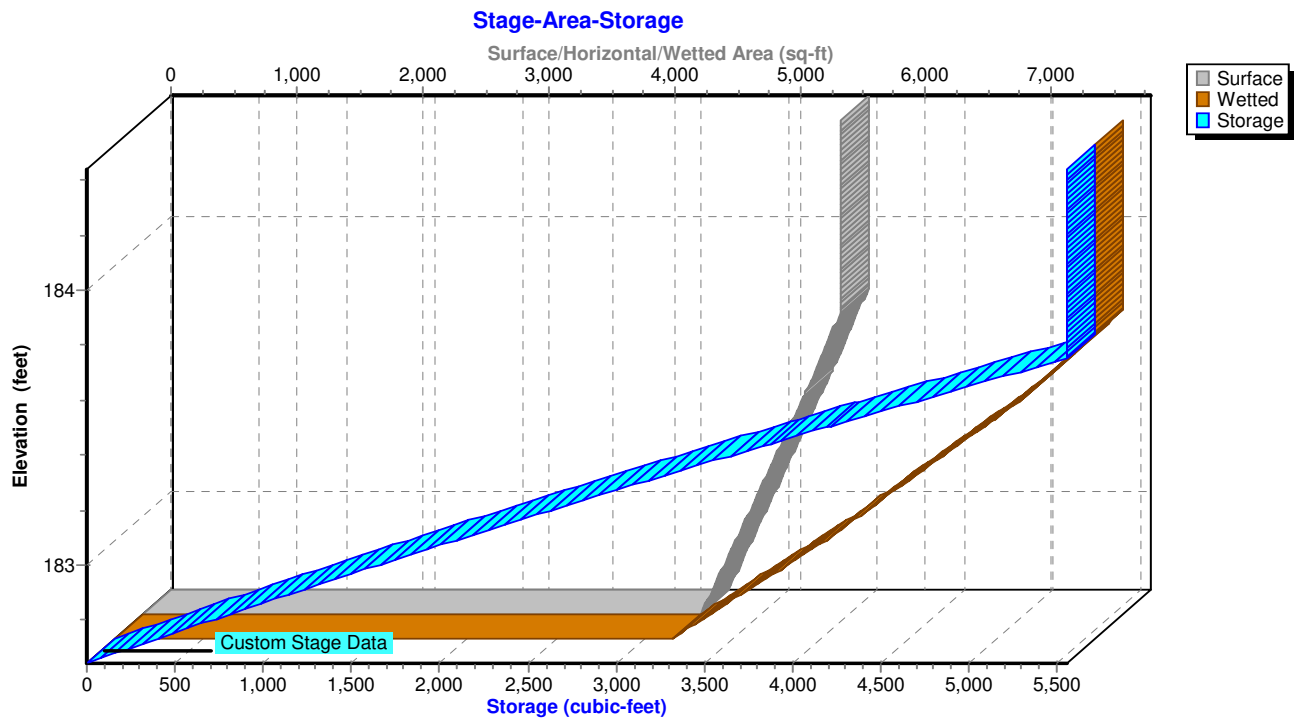
Hydrograph



Pond 1P: Detention pond

Stage-Discharge



Pond 1P: Detention pond

1520 HydroCAD Full Dev*Type IA 24-hr 10-yr Rainfall=3.50"*

Prepared by Rydell Engineering

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Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: SITE-PREDEV

Runoff Area=125,464 sf 4.92% Impervious Runoff Depth=2.32"

Tc=14.6 min CN=88/98 Runoff=1.50 cfs 24,233 cf

Subcatchment 3S: FULL- POSTDEV

Runoff Area=125,464 sf 81.29% Impervious Runoff Depth=3.11"

Tc=5.2 min CN=90/98 Runoff=2.25 cfs 32,551 cf

Pond 1P: Detention pond

Peak Elev=183.65' Storage=4,985 cf Inflow=2.25 cfs 32,551 cf

Discarded=0.00 cfs 10 cf Primary=1.22 cfs 32,540 cf Outflow=1.22 cfs 32,551 cf

Total Runoff Area = 250,928 sf Runoff Volume = 56,783 cf Average Runoff Depth = 2.72"**56.90% Pervious = 142,775 sf 43.10% Impervious = 108,153 sf**

Summary for Subcatchment 1S: SITE-PREDEV

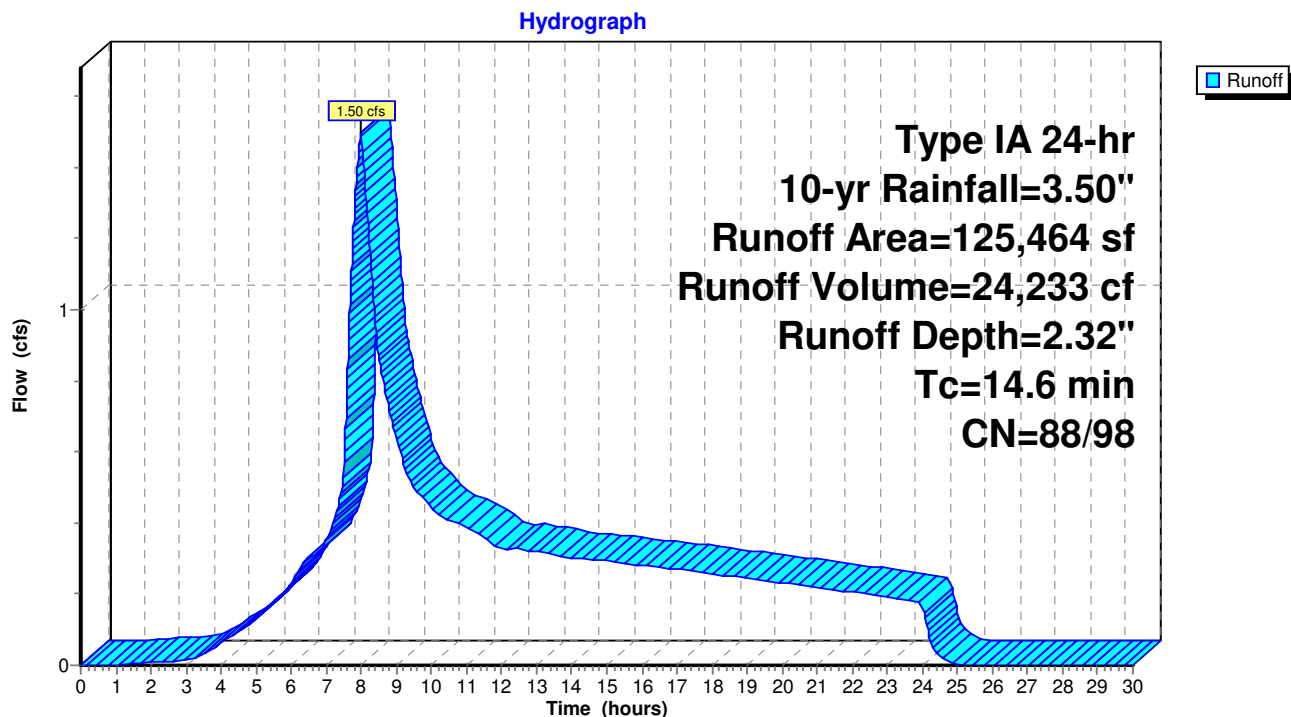
Total Site Drainage Area for Phase I = 2.607 acres

Runoff = 1.50 cfs @ 8.00 hrs, Volume= 24,233 cf, Depth= 2.32"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-yr Rainfall=3.50"

	Area (sf)	CN	Description
*	73,445	87	PASTURE HSG C/D POOR (FILL)
*	2,436	87	Pasture/grassland/range, Poor, HSG D
	37,407	89	Pasture/grassland/range, Poor, HSG D
*	6,168	98	Fire Access Driveway
*	6,008	87	Pasture/grassland/range/Poor,HSG
	125,464	88	Weighted Average
	119,296		95.08% Pervious Area
	6,168		4.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6					Direct Entry, SEE STORMWATER REPORT

Subcatchment 1S: SITE-PREDEV

1520 HydroCAD Full Dev

Type IA 24-hr 10-yr Rainfall=3.50"

Prepared by Rydell Engineering

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Summary for Subcatchment 3S: FULL- POSTDEV

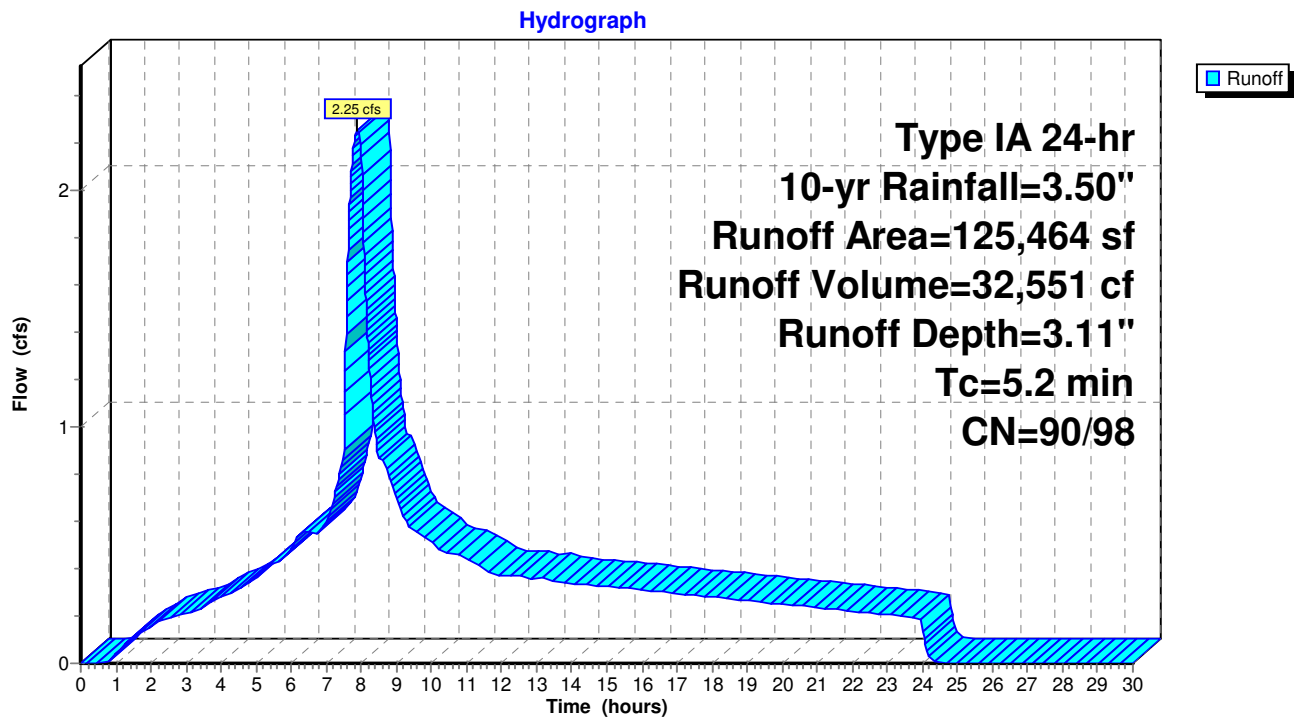
Runoff = 2.25 cfs @ 7.89 hrs, Volume= 32,551 cf, Depth= 3.11"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-yr Rainfall=3.50"

	Area (sf)	CN	Description
*	3,468	87	2300A Soils C/D
*	613	87	2301A Soils C/D
*	410	89	2306A Soils D
*	19,925	98	Phase I Storage Building
*	21,901	98	Access Road and Parking
*	10,145	92	Landscape Side Slopes
*	7,723	89	Rain Gardens
*	1,120	92	Pond Banks
*	16,031	98	Center Future Access
*	13,553	98	West Future Access
*	7,200	98	East Future Building
*	14,625	98	Center Future Building
*	8,750	98	West Future Building
	125,464	97	Weighted Average
	23,479		18.71% Pervious Area
	101,985		81.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2					Direct Entry, EAST POST DEVELOPMENT

Subcatchment 3S: FULL- POSTDEV



Summary for Pond 1P: Detention pond

Inflow Area = 125,464 sf, 81.29% Impervious, Inflow Depth = 3.11" for 10-yr event
 Inflow = 2.25 cfs @ 7.89 hrs, Volume= 32,551 cf
 Outflow = 1.22 cfs @ 8.25 hrs, Volume= 32,551 cf, Atten= 46%, Lag= 21.6 min
 Discarded = 0.00 cfs @ 8.25 hrs, Volume= 10 cf
 Primary = 1.22 cfs @ 8.25 hrs, Volume= 32,540 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 183.65' @ 8.25 hrs Surf.Area= 5,457 sf Storage= 4,985 cf

Plug-Flow detention time= 78.7 min calculated for 32,551 cf (100% of inflow)
 Center-of-Mass det. time= 78.7 min (753.2 - 674.5)

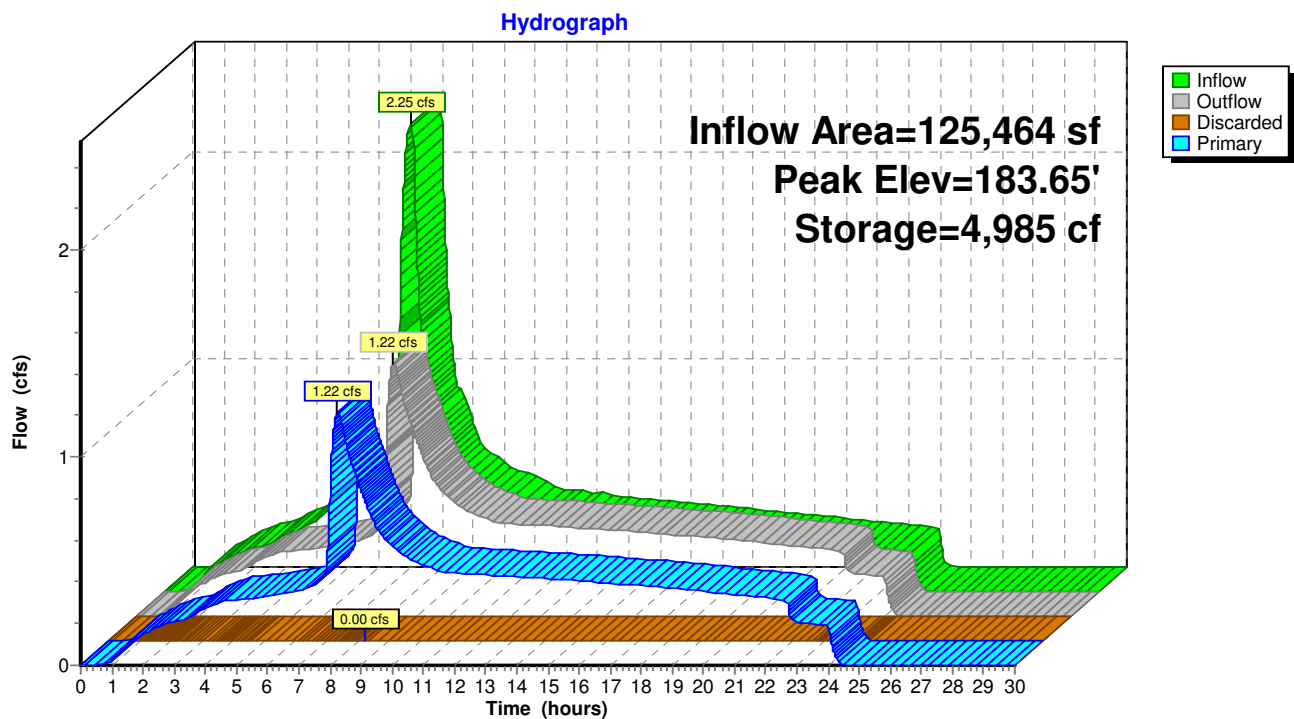
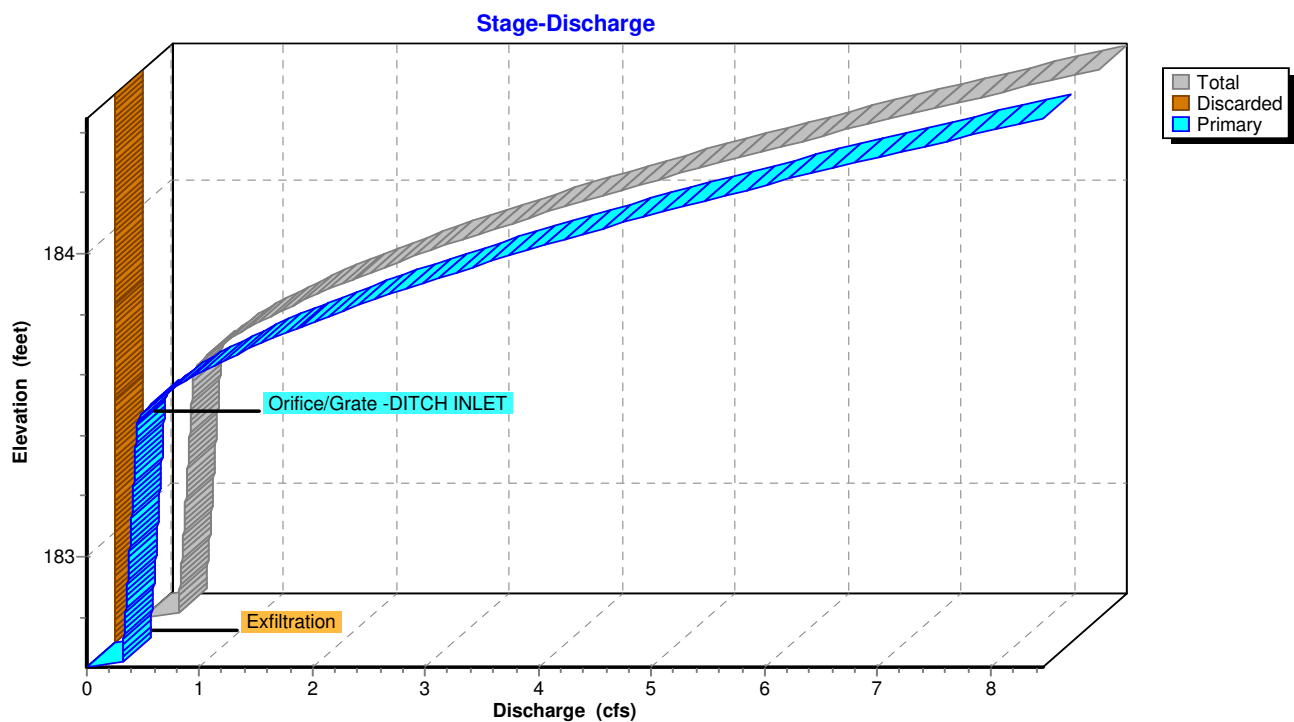
Volume	Invert	Avail.Storage	Storage Description
#1	182.64'	5,553 cf	Custom Stage Data (Irregular) Listed below (Recalc)

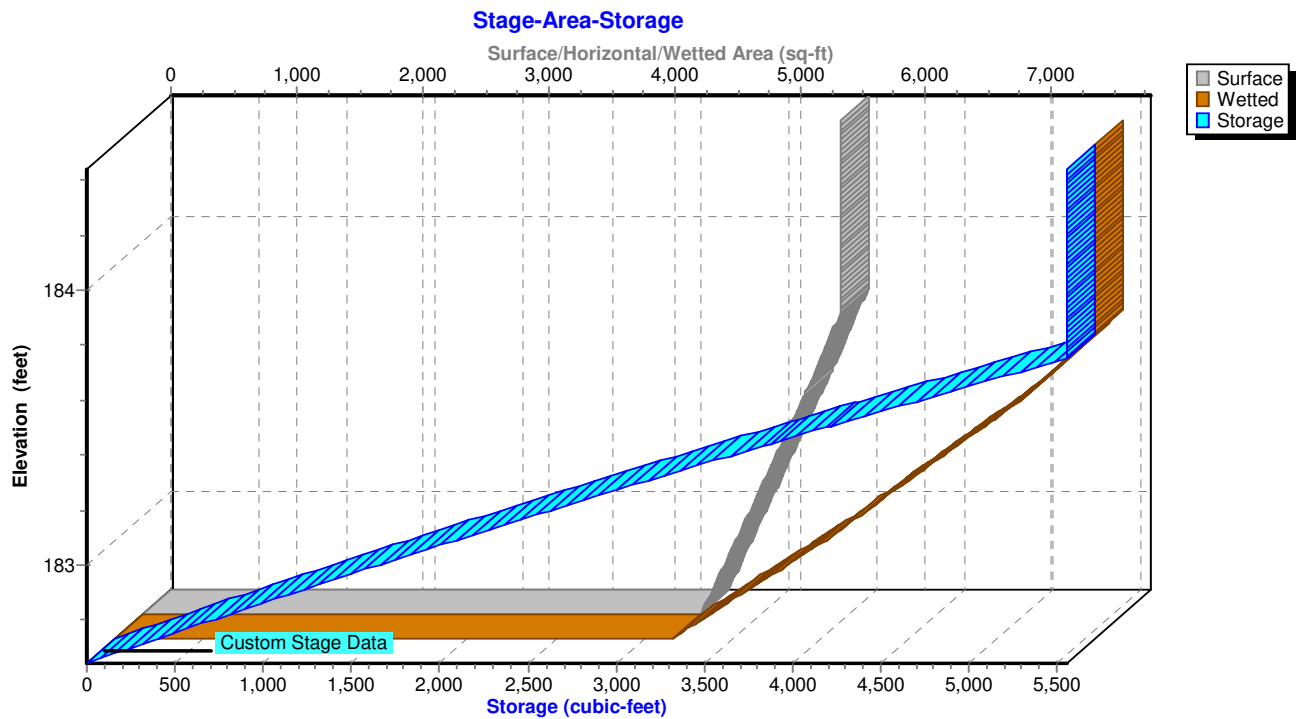
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
182.64	4,433	499.0	0	0	4,433
183.00	4,807	514.0	1,663	1,663	5,656
183.50	5,321	532.0	2,531	4,194	7,177
183.75	5,553	539.0	1,359	5,553	7,788

Device	Routing	Invert	Outlet Devices
#1	Primary	181.75'	3.7" Vert. Orifice/Grate 2-YR C= 0.600
#2	Primary	183.44'	29.5" W x 12.0" H Vert. Orifice/Grate -DITCH INLET C= 0.600
#3	Discarded	182.64'	0.001 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.00 cfs @ 8.25 hrs HW=183.65' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=1.22 cfs @ 8.25 hrs HW=183.65' (Free Discharge)
 ↑ **1=Orifice/Grate 2-YR** (Orifice Controls 0.47 cfs @ 6.36 fps)
 ↑ **2=Orifice/Grate -DITCH INLET** (Orifice Controls 0.74 cfs @ 1.46 fps)

Pond 1P: Detention pond**Pond 1P: Detention pond**

Pond 1P: Detention pond

1520 HydroCAD Full Dev*Type IA 24-hr 25-yr Rainfall=4.00"*

Prepared by Rydell Engineering

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Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: SITE-PREDEV

Runoff Area=125,464 sf 4.92% Impervious Runoff Depth=2.78"

Tc=14.6 min CN=88/98 Runoff=1.82 cfs 29,064 cf

Subcatchment 3S: FULL- POSTDEV

Runoff Area=125,464 sf 81.29% Impervious Runoff Depth=3.61"

Tc=5.2 min CN=90/98 Runoff=2.60 cfs 37,710 cf

Pond 1P: Detention pond

Peak Elev=183.75' Storage=5,527 cf Inflow=2.60 cfs 37,710 cf

Discarded=0.00 cfs 11 cf Primary=1.82 cfs 37,699 cf Outflow=1.82 cfs 37,710 cf

Total Runoff Area = 250,928 sf Runoff Volume = 66,774 cf Average Runoff Depth = 3.19"**56.90% Pervious = 142,775 sf 43.10% Impervious = 108,153 sf**

Summary for Subcatchment 1S: SITE-PREDEV

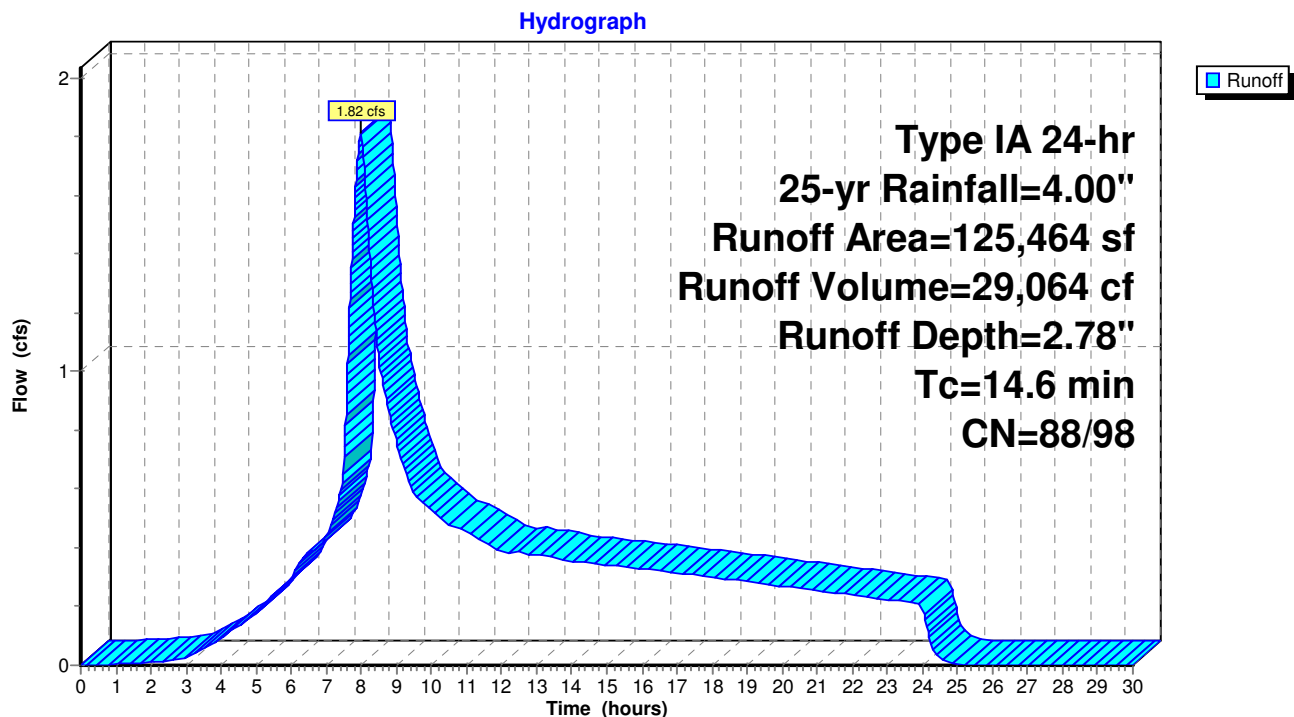
Total Site Drainage Area for Phase I = 2.607 acres

Runoff = 1.82 cfs @ 8.00 hrs, Volume= 29,064 cf, Depth= 2.78"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-yr Rainfall=4.00"

	Area (sf)	CN	Description
*	73,445	87	PASTURE HSG C/D POOR (FILL)
*	2,436	87	Pasture/grassland/range, Poor, HSG D
	37,407	89	Pasture/grassland/range, Poor, HSG D
*	6,168	98	Fire Access Driveway
*	6,008	87	Pasture/grassland/range/Poor,HSG
	125,464	88	Weighted Average
	119,296		95.08% Pervious Area
	6,168		4.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6					Direct Entry, SEE STORMWATER REPORT

Subcatchment 1S: SITE-PREDEV

1520 HydroCAD Full Dev

Type IA 24-hr 25-yr Rainfall=4.00"

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Summary for Subcatchment 3S: FULL- POSTDEV

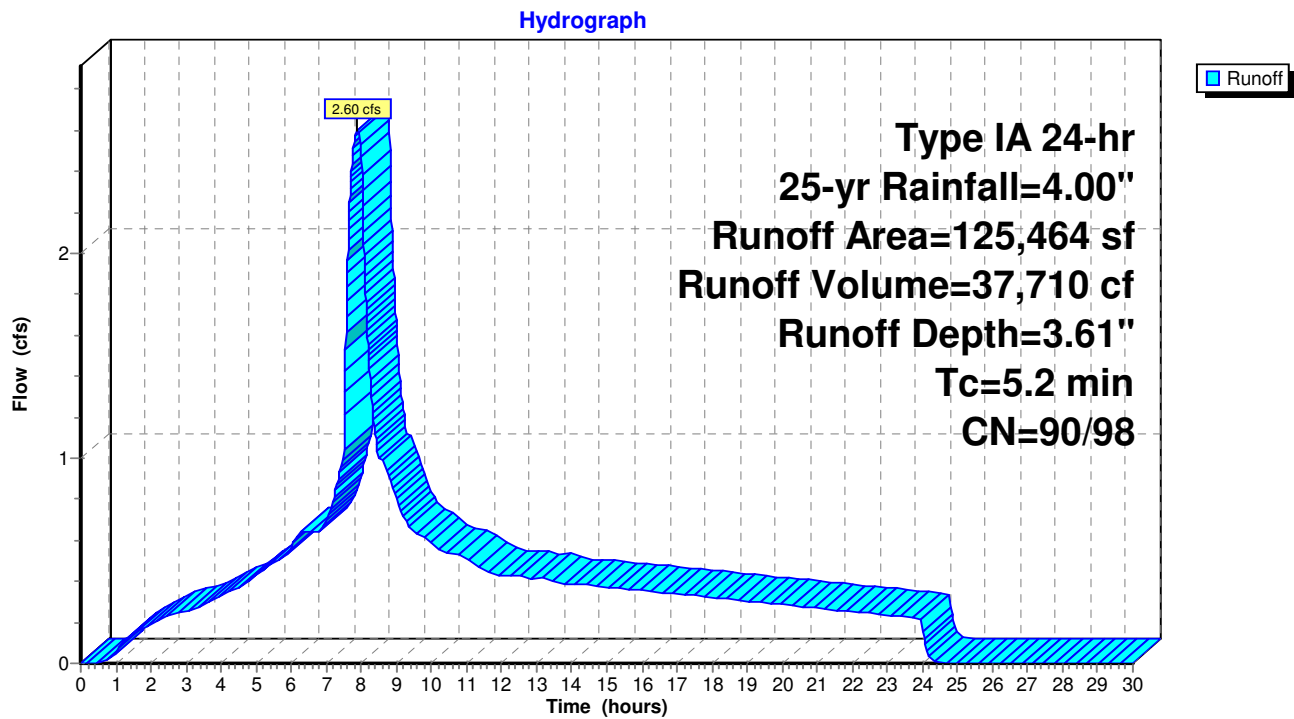
Runoff = 2.60 cfs @ 7.89 hrs, Volume= 37,710 cf, Depth= 3.61"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-yr Rainfall=4.00"

	Area (sf)	CN	Description
*	3,468	87	2300A Soils C/D
*	613	87	2301A Soils C/D
*	410	89	2306A Soils D
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*	1,120	92	Pond Banks
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*	13,553	98	West Future Access
*	7,200	98	East Future Building
*	14,625	98	Center Future Building
*	8,750	98	West Future Building
	125,464	97	Weighted Average
	23,479		18.71% Pervious Area
	101,985		81.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2					Direct Entry, EAST POST DEVELOPMENT

Subcatchment 3S: FULL- POSTDEV



Summary for Pond 1P: Detention pond

Inflow Area = 125,464 sf, 81.29% Impervious, Inflow Depth = 3.61" for 25-yr event
 Inflow = 2.60 cfs @ 7.89 hrs, Volume= 37,710 cf
 Outflow = 1.82 cfs @ 8.12 hrs, Volume= 37,710 cf, Atten= 30%, Lag= 13.8 min
 Discarded = 0.00 cfs @ 8.12 hrs, Volume= 11 cf
 Primary = 1.82 cfs @ 8.12 hrs, Volume= 37,699 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 183.75' @ 8.12 hrs Surf.Area= 5,549 sf Storage= 5,527 cf

Plug-Flow detention time= 85.2 min calculated for 37,710 cf (100% of inflow)
 Center-of-Mass det. time= 85.2 min (755.8 - 670.6)

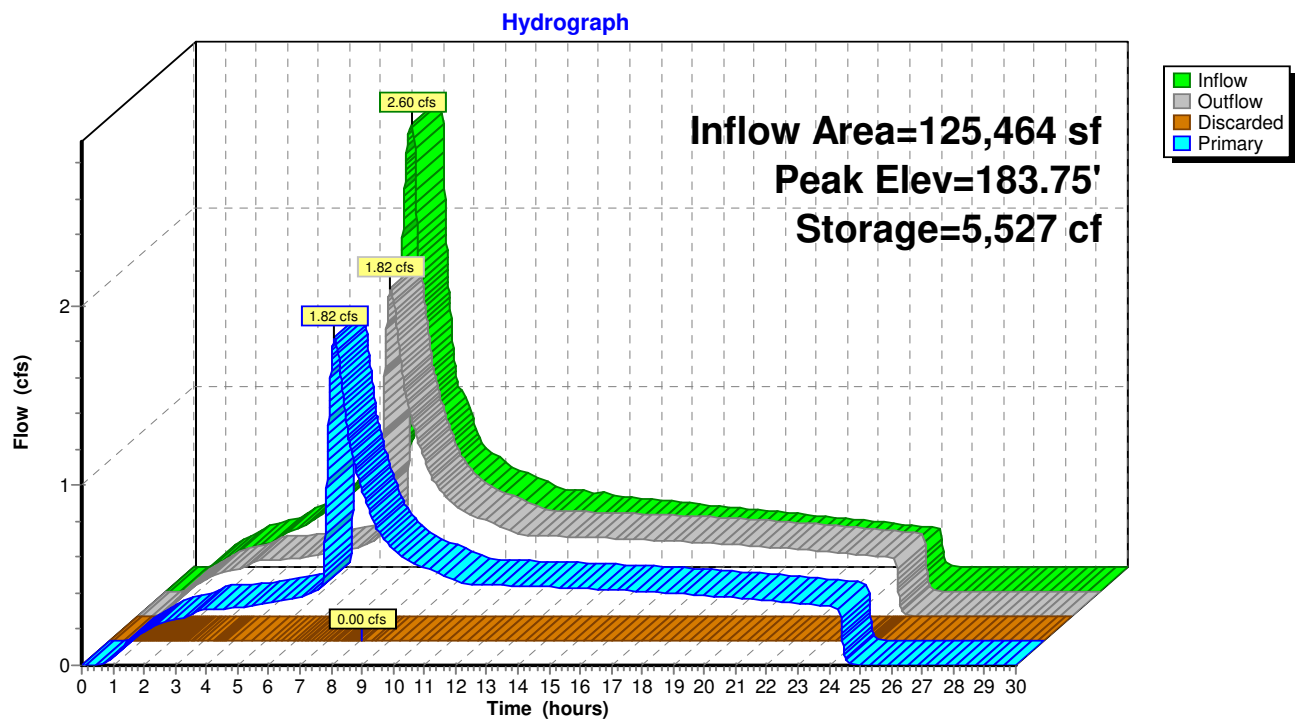
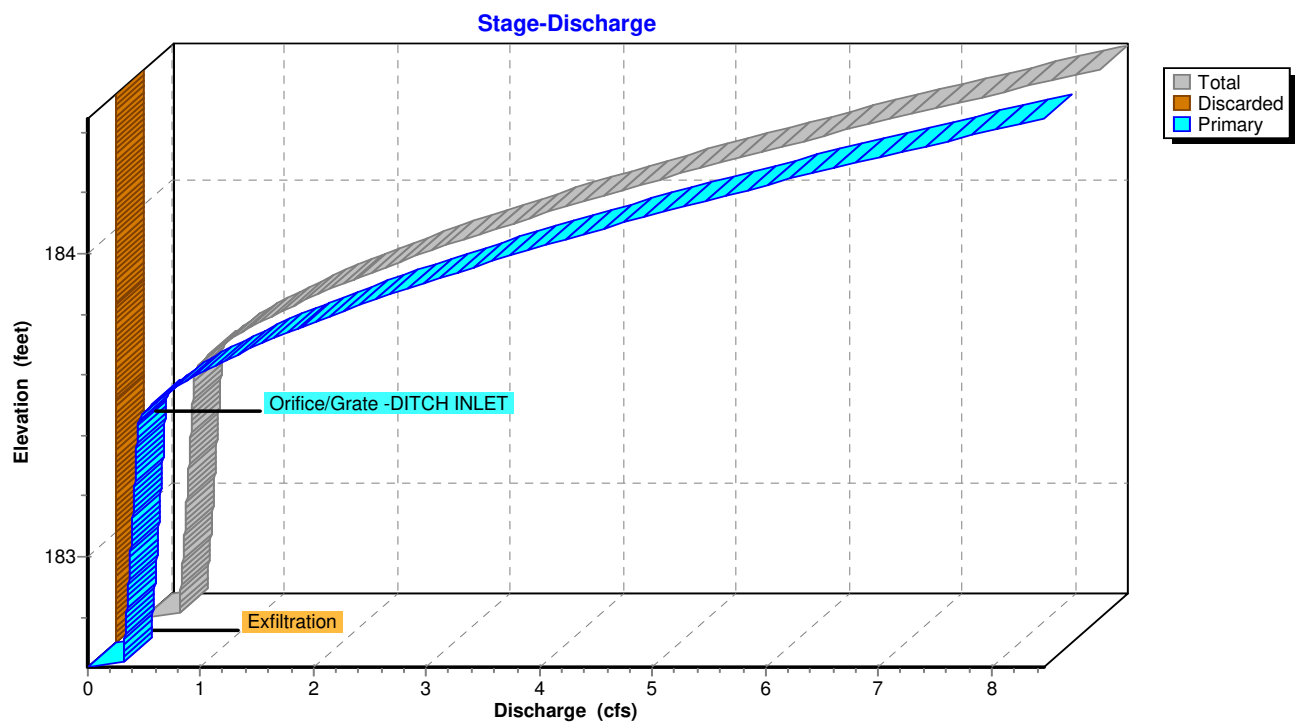
Volume	Invert	Avail.Storage	Storage Description
#1	182.64'	5,553 cf	Custom Stage Data (Irregular) Listed below (Recalc)

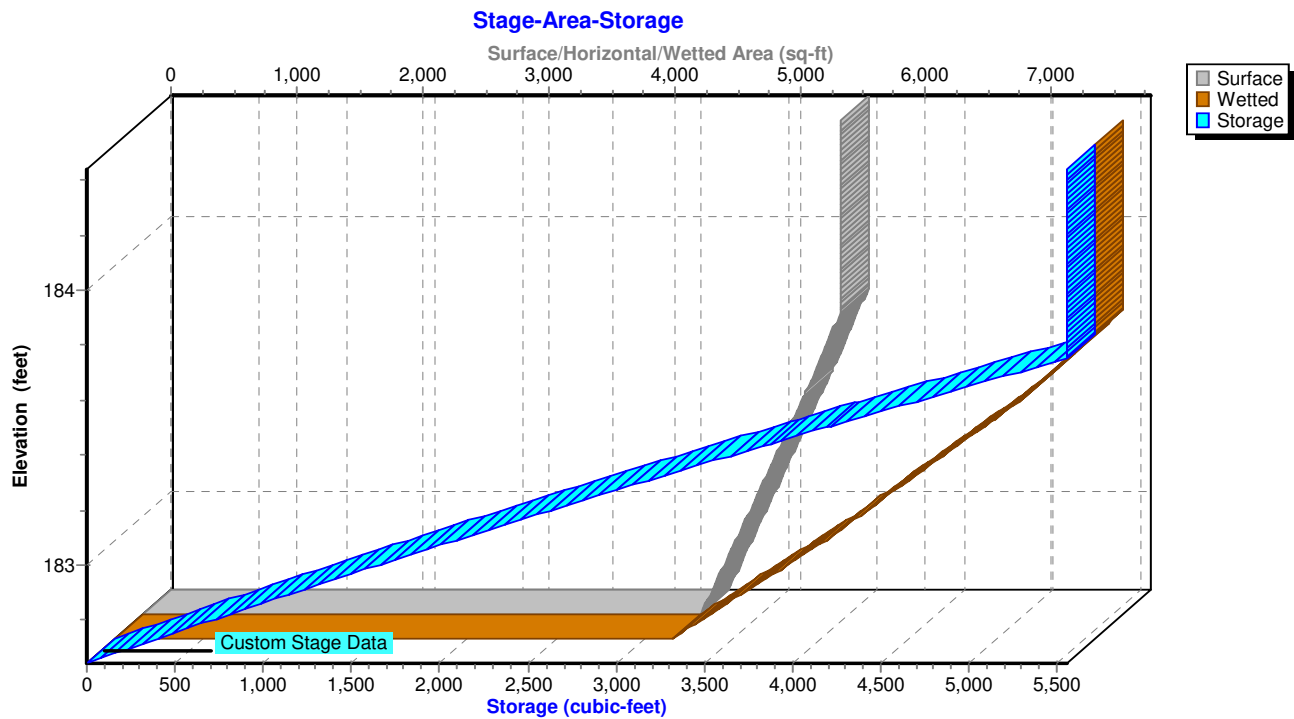
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
182.64	4,433	499.0	0	0	4,433
183.00	4,807	514.0	1,663	1,663	5,656
183.50	5,321	532.0	2,531	4,194	7,177
183.75	5,553	539.0	1,359	5,553	7,788

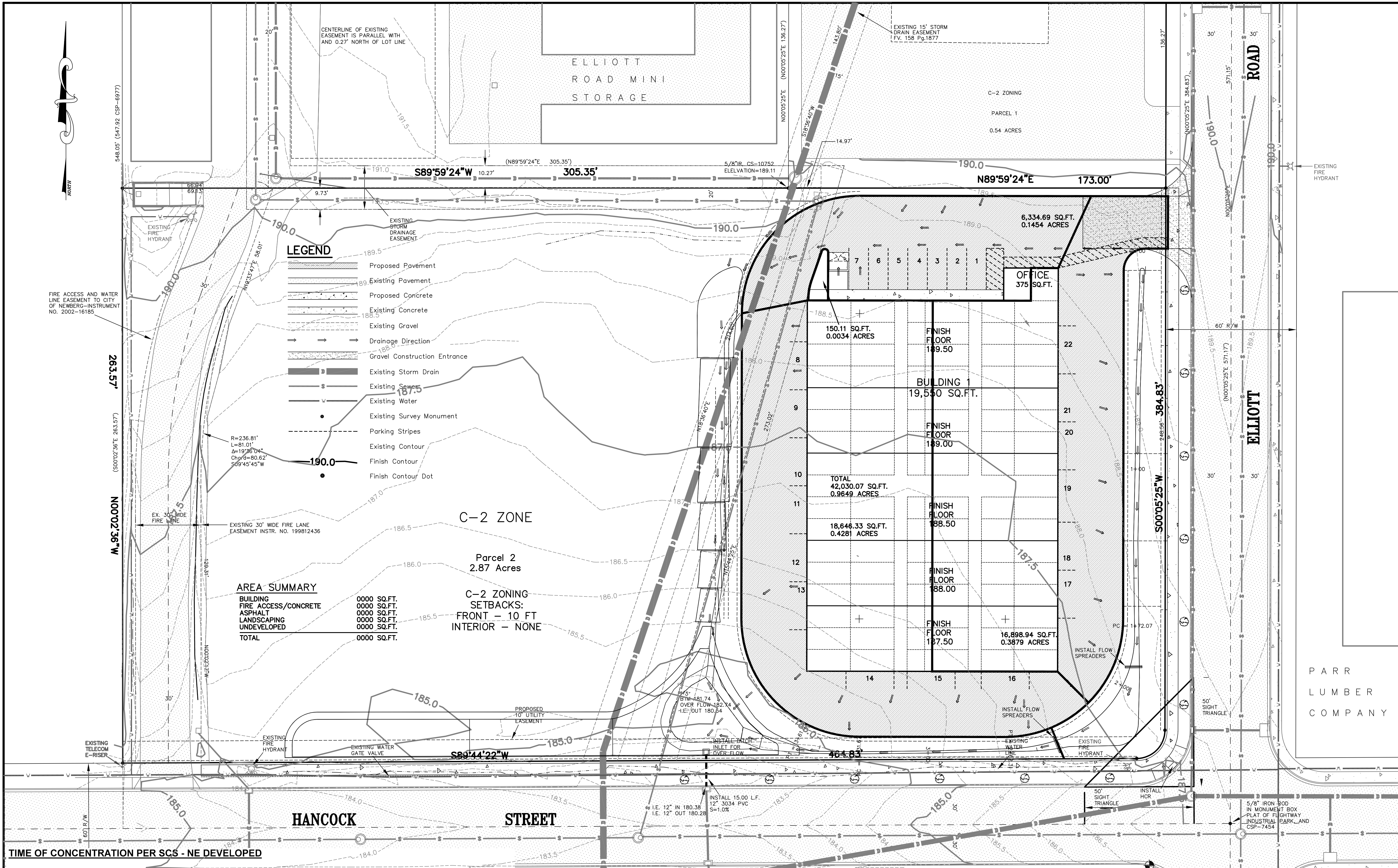
Device	Routing	Invert	Outlet Devices
#1	Primary	181.75'	3.7" Vert. Orifice/Grate 2-YR C= 0.600
#2	Primary	183.44'	29.5" W x 12.0" H Vert. Orifice/Grate -DITCH INLET C= 0.600
#3	Discarded	182.64'	0.001 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.00 cfs @ 8.12 hrs HW=183.75' (Free Discharge)
 ↑ **3=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=1.82 cfs @ 8.12 hrs HW=183.75' (Free Discharge)
 ↑ **1=Orifice/Grate 2-YR** (Orifice Controls 0.49 cfs @ 6.53 fps)
 ↓ **2=Orifice/Grate -DITCH INLET** (Orifice Controls 1.33 cfs @ 1.77 fps)

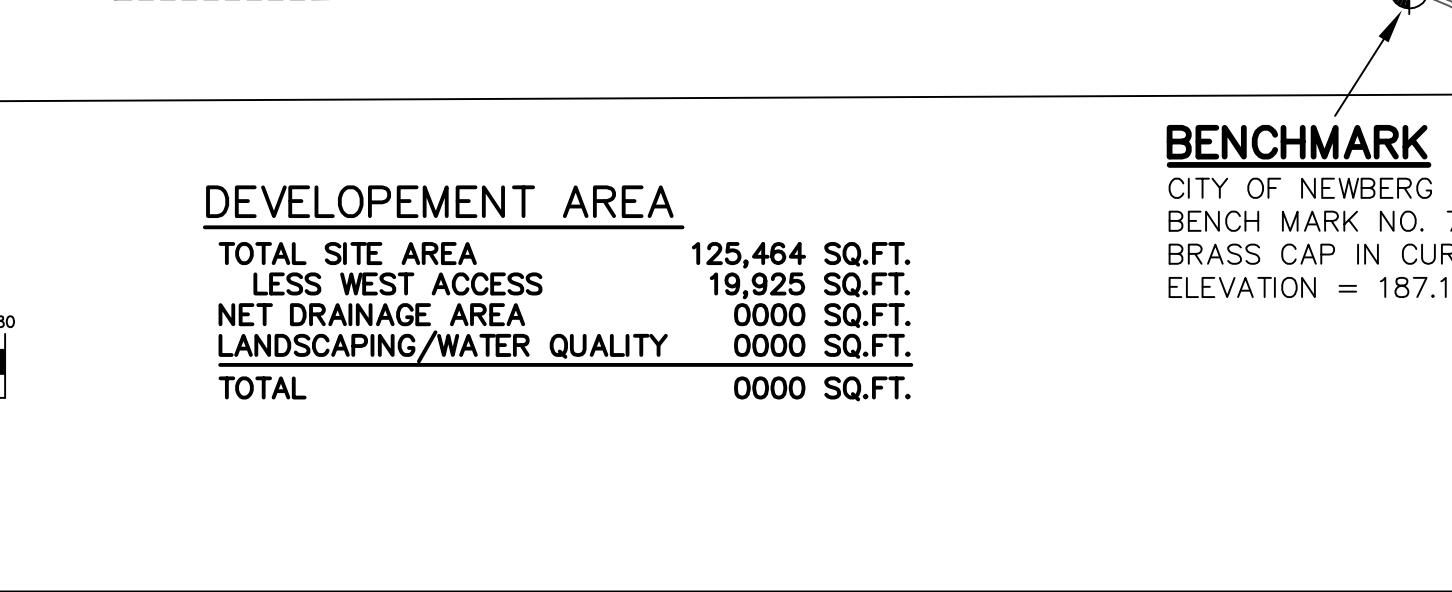
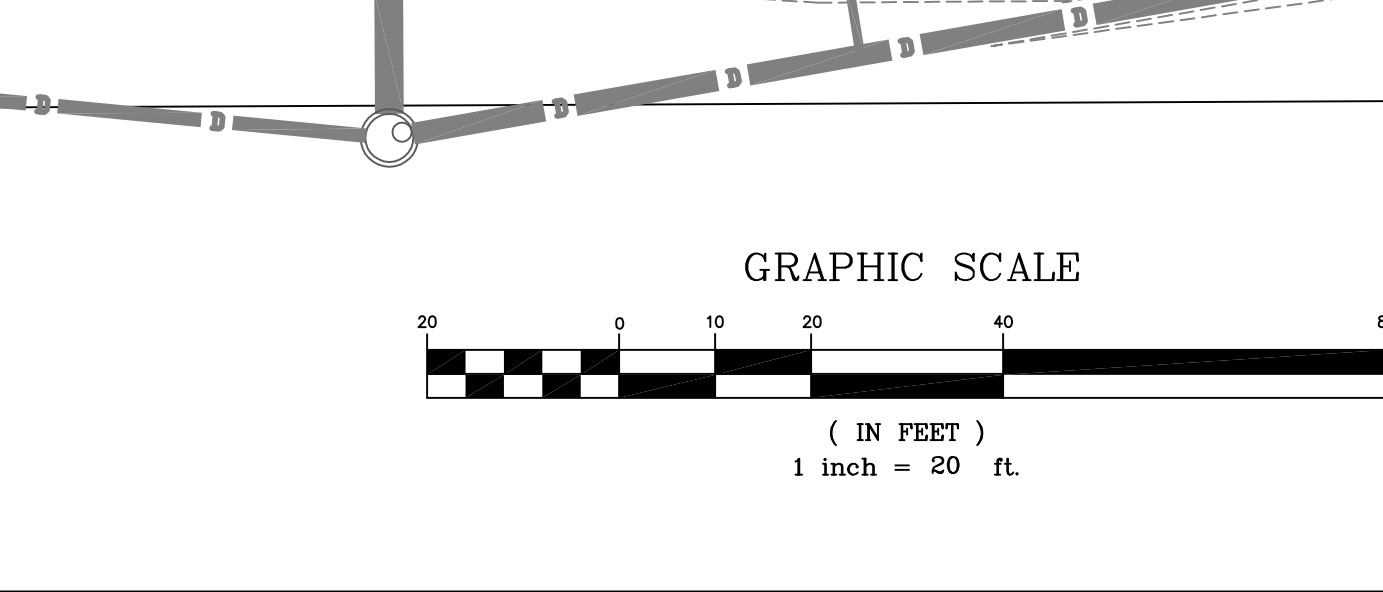
Pond 1P: Detention pond**Pond 1P: Detention pond**

Pond 1P: Detention pond



TIME OF CONCENTRATION PER SCS - NE DEVELOPED

PRE-DEVELOP (2 YR)									
RUN	BEGIN STA	END STA	LENGTH	BEG. ELEV	END ELEV	SLOPE	METHOD	MANNINGS "K"	"N" "I" or "D" FT/SEC
RUN NO. 1	0.00	70.18		190.04	189.00	1.48%	Kin.Wave	0.011	2.50
RUN NO. 2	70.18	79.66	9.48	189.00	187.90	11.60%	Shallow	11	0.03
RUN NO. 3	79.66	134.07	54.41	187.31	187.31	1.08%	Shallow	11	0.03
RUN NO. 4	134.07	204.01	69.94	187.31	186.59	1.03%	Shallow	11	0.03
RUN NO. 5	204.01	251.73	47.72	186.59	186.04	1.15%	Shallow	11	0.03
RUN NO. 6	251.73	301.46	49.73	186.04	185.72	0.64%	Shallow	11	0.03
RUN NO. 7	301.46	364.46	63.00	185.72	184.88	1.33%	Channel	17	0.03
RUN NO. 8	364.46	397.75	33.29	184.88	184.26	1.86%	Channel	17	0.03
RUN NO. 9	397.75	419.39	21.64	184.26	183.87	1.80%	Channel	17	0.03
RUN NO. 10	419.39	443.43	24.04	183.87	182.75	4.66%	Channel	17	0.03
TOTAL TIME TO OUTLET			443.43						



2016 DEVELOPMENT SITE CONDITIONS
A STORAGE PLACE HANCOCK
Located in the Northeast 1/4 of the Northeast 1/4 of Section 20
Township 3 South, Range 2 West of the Willamette Meridian
City of Newberg, Yamhill County, Oregon

Prepared for:
A Storage Place Hancock LLC
P. O. Box 5717
Santa Barbara, CA 93150
Phone: (503) 708-2775
E-Mail: pamandjc@gmail.com

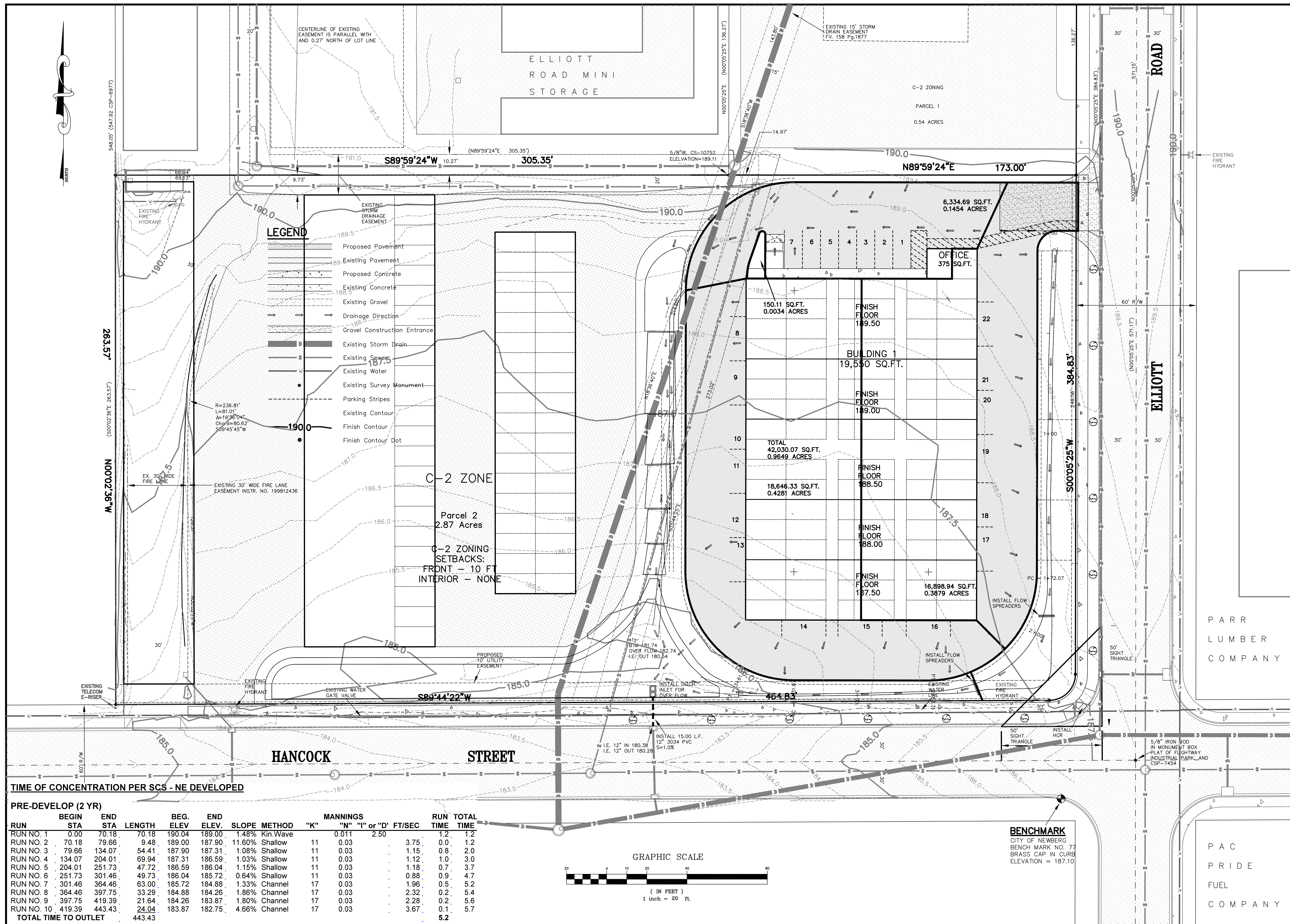
W.O. No.: 1520
Design: [Signature]
Drawn: [Signature]
Date: 7 September 2016
Dwg: 1520-SR3.DWG


Sheet
3 of 4

REVISIONS			
No.	Description/Date	By	

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601 Pinhurst Drive, Newberg, Oregon 97132
Mobile (503) 781-4138
FAX (503) 538-9167
larrydell@earthlink.net
Consulting Civil Engineer - Land Surveyor - W.R.E.

RENEWAL DATE: 12/31/2012



 **LEONARD A. RYDELL, P.E., P.L.S.**
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Mobile (503) 781-4138
Fax (503) 538-9167
larrydell@earthlink.net
Consulting Civil Engineer – Land Surveyor – W.R.E.

RENEWAL DATE 12/31/2012

**FULL DEVELOPMENT SITE CONDITIONS
A STORAGE PLACE HANCOCK**
Located in the Northeast 1/4 of the Northeast 1/4 of Section 20
Township 3 South, Range 2 West of the Willamette Meridian
City of Newberg, Yamhill County, Oregon

Prepared for:
A Storage Place-Hancock
P. O. Box 5717
Santa Barbara, CA 93150
Phone: (503) 708-2775
paemandjc@gmail.com

W.O. No. 1520
Design *Howard D. Lyell*
Drawn *John R. D. ...*
Date 7 September 2016
Dwg 1520-SR4.DWG

[illegible]